THE American JOURNAL OF Surgery

JUNE 1956

THURSTON SCOTT WELTON, M.D., EDITOR

Osteoid Osteoma of Spine

The Postphlebitic Syndrome

Pulmonary Arteriovenous Aneurysm

Index Issue Vol. 91

SIXTY-FIFTH YEAR OF PUBLICATION

JUNE 1956

THE American JOURNAL OF Surgery

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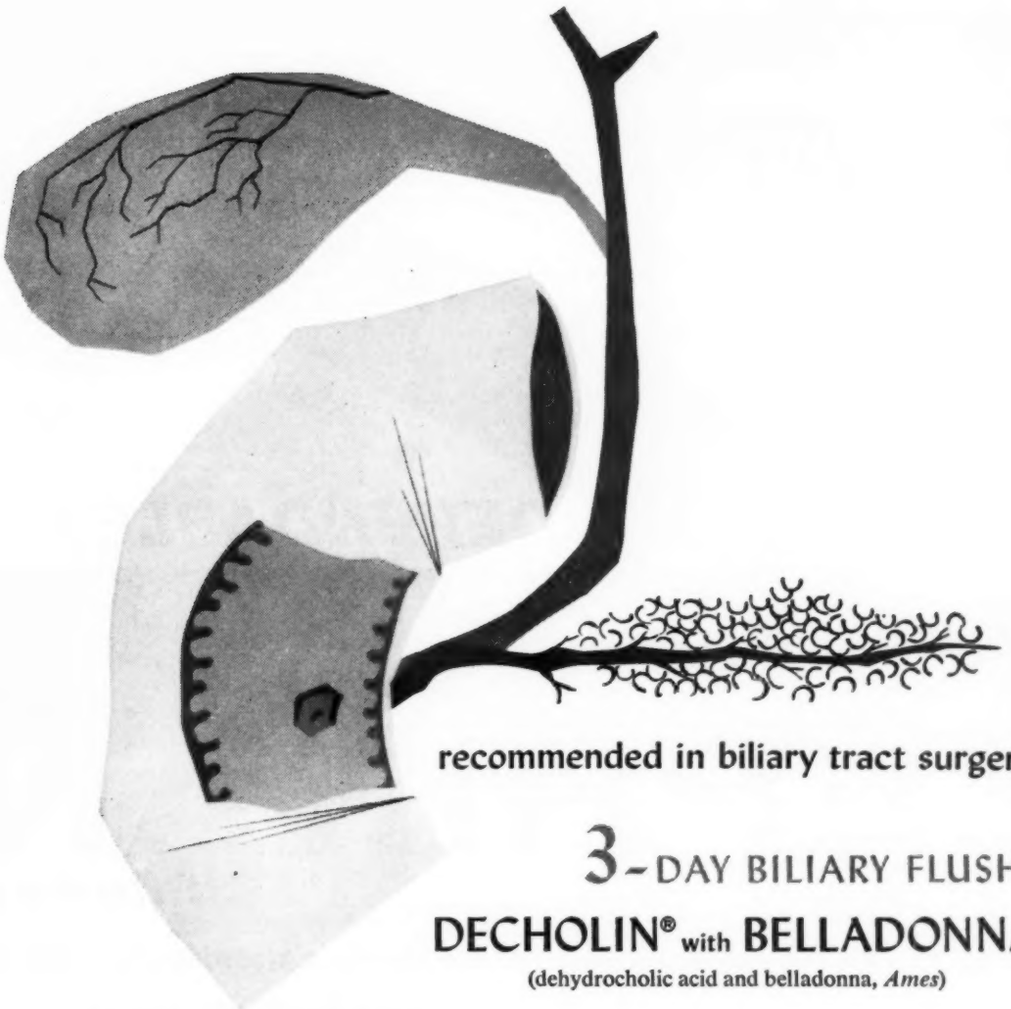

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ALVINA O. SABANAS, WILLIAM H. BICKEL AND JOHN H. MOE

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The American Journal of Surgery is published monthly by The American Journal of Surgery, Inc., 49 West 45th Street, New York 36, N. Y. Yearly Subscription, $15.00 U. S. A.; $16.00 Canada; $17.00 Foreign including Pan-American Countries. Single Numbers $2.00; Special and Symposia Numbers $4.00. Reentered as second class matter February 7, 1951, at the Post Office, New York, N. Y., and on February 7, 1951, at York, Pa., under the Act of March 3, 1879. June, 1956—New Series, Volume 91, No. 6. *Copyright©, 1956, by The American Journal of Surgery, Inc.*

MANUSCRIPTS: All manuscripts should be addressed to the Editorial Office of the Journal, 49 West 45th Street, New York 36, N. Y.

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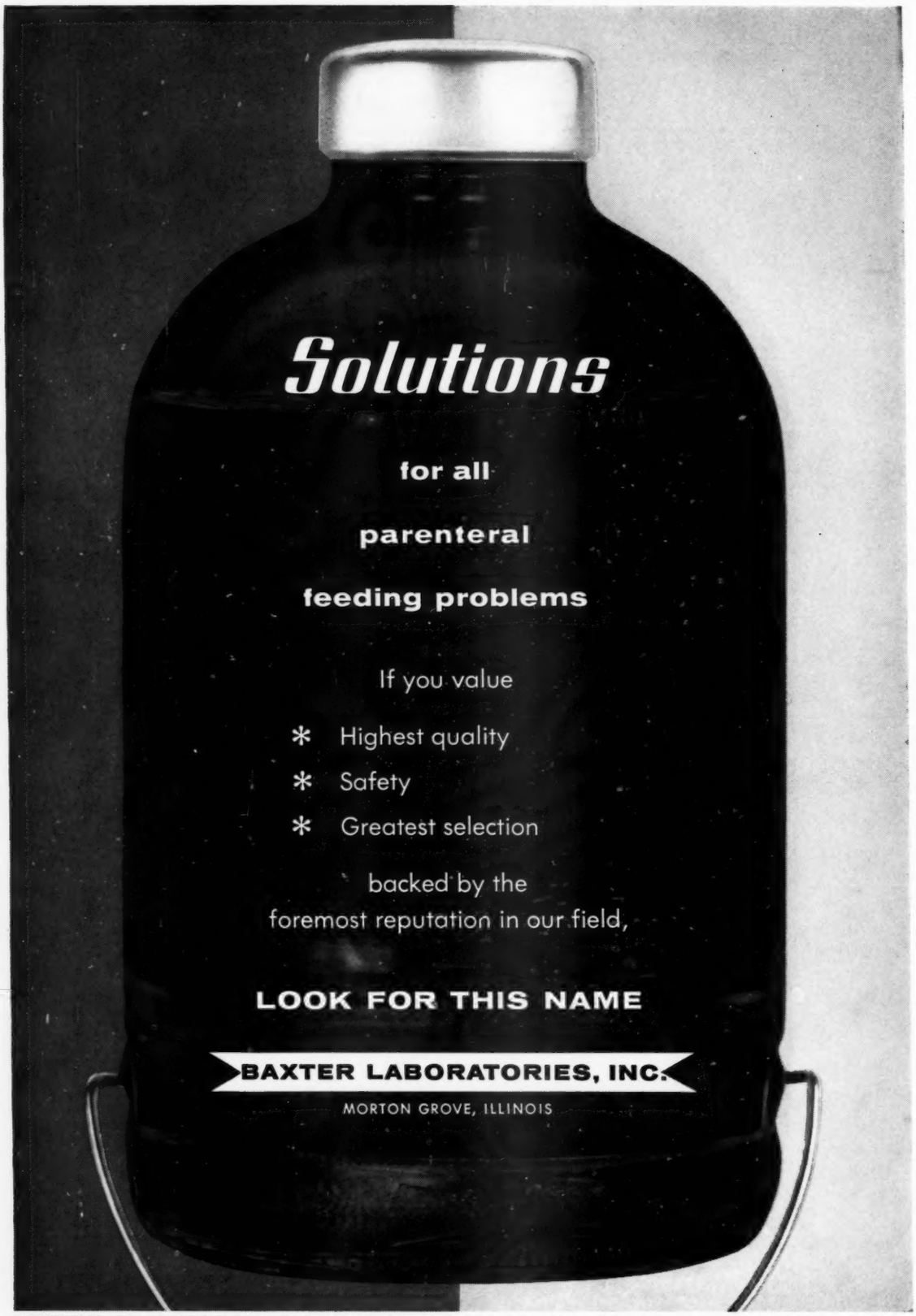

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CHARLES GILFILLAN

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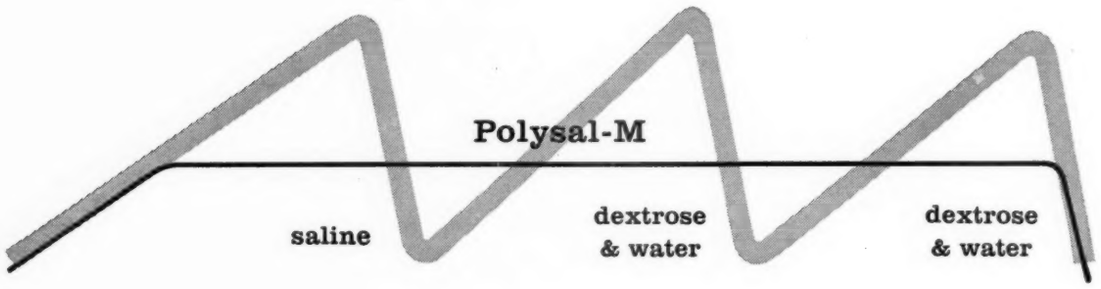

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*Talbot, N. B., Crawford, J. D., and Butler, A. M., "Homeostatic Limits to Safe Parenteral Therapy". New Engl. J. Med., 248, 1100 (1953)

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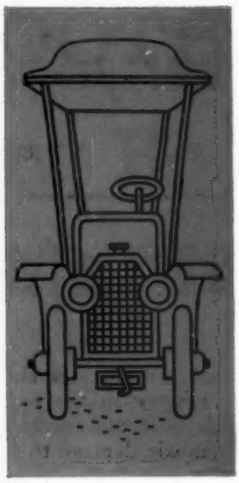

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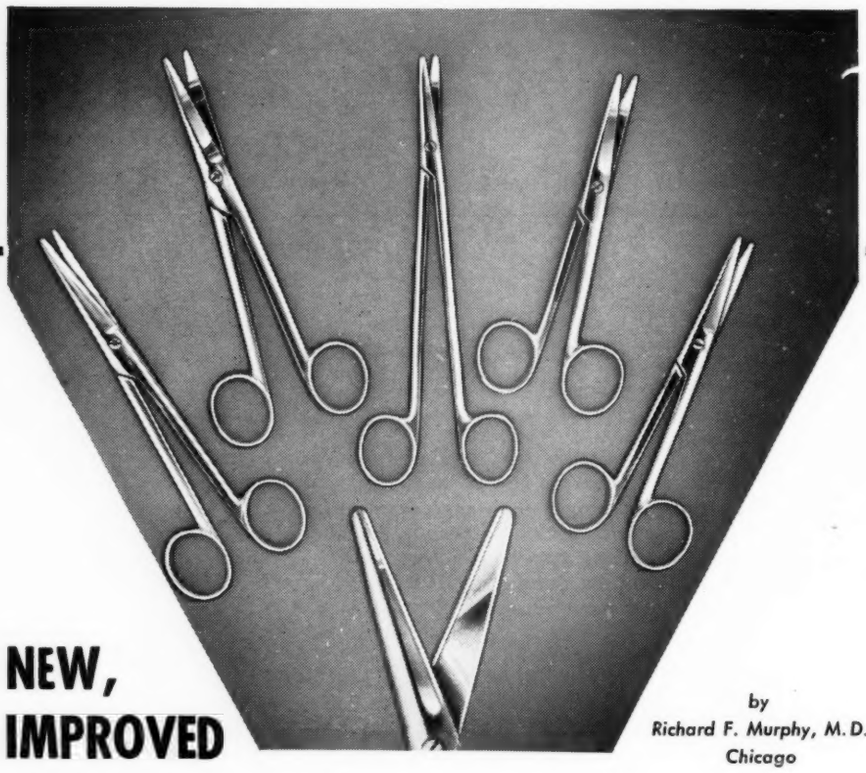

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L. KRAEER FERGUSON

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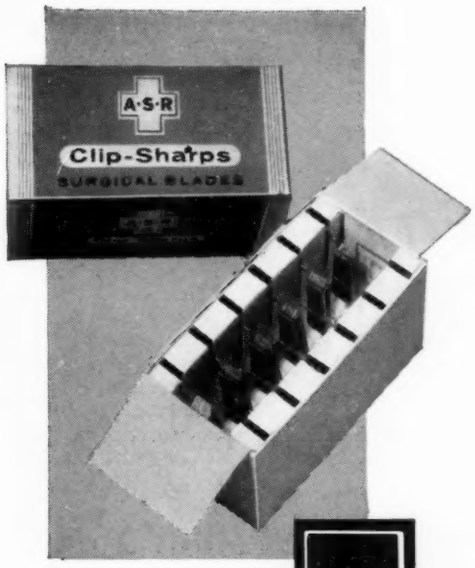

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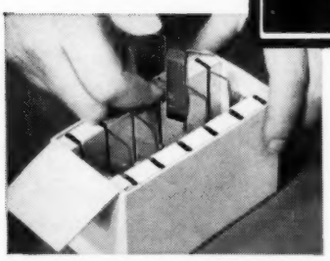

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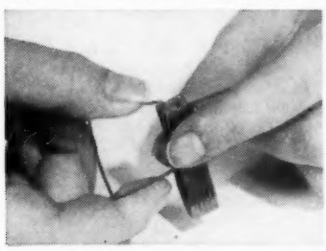

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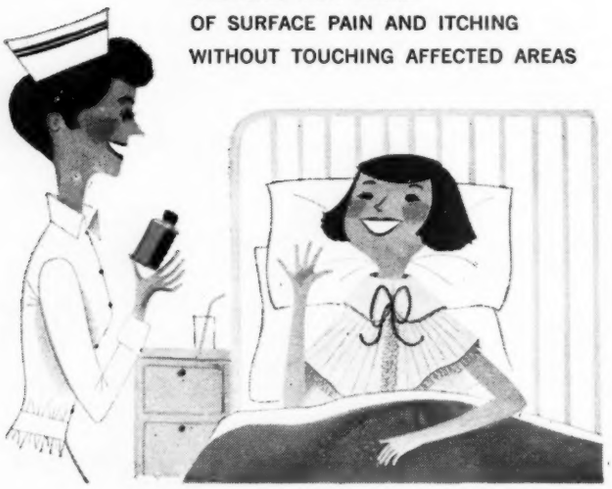

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The Use of the Systemic Hemostat Carbazochrome Salicylate

J. C. Bacala, M.D.

(Abstracted from the Western Journal of Surgery, Obstetrics, and Gynecology, 64:88 (1956)

The author emphasizes the need for dependable chemical control of bleeding and oozing, and reviews the methods that have been tried to attain hemostasis, including the use of vitamin K and bioflavonoids.

He gives the history of carbazochrome salicylate and describes the clinical work completed to demonstrate its effectiveness. It appears to be specific for conditions characterized by increased capillary permeability. It has no effect on large blood vessels; it does not alter blood components; it does not affect blood pressure or cardiac rate. It has neither vasoconstrictor or vasodilator action. The drug has no known contraindications.

He reviews 1051 cases from the files of St. Anthony Hospital, Louisville, Kentucky, of which 330 were treated with Adrenosem Salicylate. 317 were surgical cases and 13 obstetric-gynecological conditions. The treatment was given for symptomatic relief, and as a clinical recourse for patient safety.

In 1015 tonsillectomy patients the following results were noted: There was bleeding in 85 (19.8%) of 429 patients who received no medication. Patients who received a compound of oxalic and malonic acids numbered 115. Of these 16 (14%), developed bleeding. Of 248 patients receiving vitamin K preparations, 47 (19%) had postoperative hemorrhage. 233 patients received Adrenosem Salicylate. Of this group, only 16 (7%) had bleeding.

In other surgical conditions, Adrenosem was used successfully in gastrointestinal bleeding, cataract extraction, incisional seepage, and transurethral prostatectomy. It was also effective in 12 cases of epistaxis.

In the field of obstetrics and gynecology, Adrenosem controlled bleeding in menometrorrhagia, hymeneal laceration, cervical ooze, antepartum and postpartum bleeding, threatened abortion, and in two cases of surgery during pregnancy.

The author points out that in pregnancy, seepage bleeding occurs more because of capillary permeability, and in spite of increased coagulability. Here, Adrenosem becomes specific for strengthening capillary resistance.

Many of the observations in this study, however, involved bleeding incident to trauma of incision, retraction, dissection, tearing and stretching. In these conditions, he reasons that Adrenosem causes hemostasis by its effect on the capillary intercellular cement substance so that the cells draw closer together, and the ends of the capillaries constrict, causing a "self-clamping" mechanism.

The S. E. MASSENGILL company

Bristol, Tennessee New York Kansas City San Francisco

FILMS showing the uses of

Adrenosem®

Salicylate

(*brand of carbazochrome salicylate*)

in the control of bleeding

Films in color, demonstrating the uses of Adrenosem Salicylate* in surgery, are now available for showing to hospitals, medical societies and group meetings. Write to Film Division, S. E. Massengill Co., Bristol, Tennessee.

Send for comprehensive illustrated brochure describing the action and uses of this unique systemic hemostat.

INDICATED *preoperatively and postoperatively to control bleeding associated with:*

Tonsillectomy, adenoidectomy and nasopharynx surgery
Prostatic and bladder surgery
Dental surgery
Chest surgery and chronic pulmonary bleeding
Uterine bleeding and postpartum hemorrhage
Also: Idiopathic purpura, retinal hemorrhage, familial telangiectasis, epistaxis, hematuria

Supplied in ampuls, oral tablets and as a syrup.

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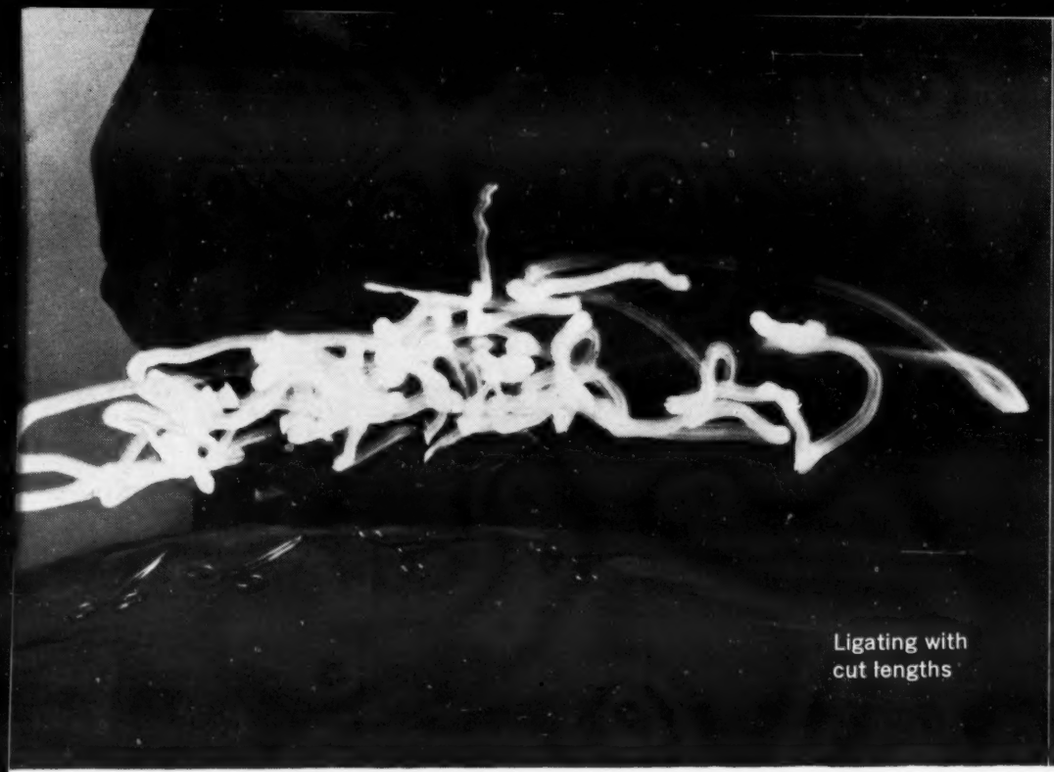
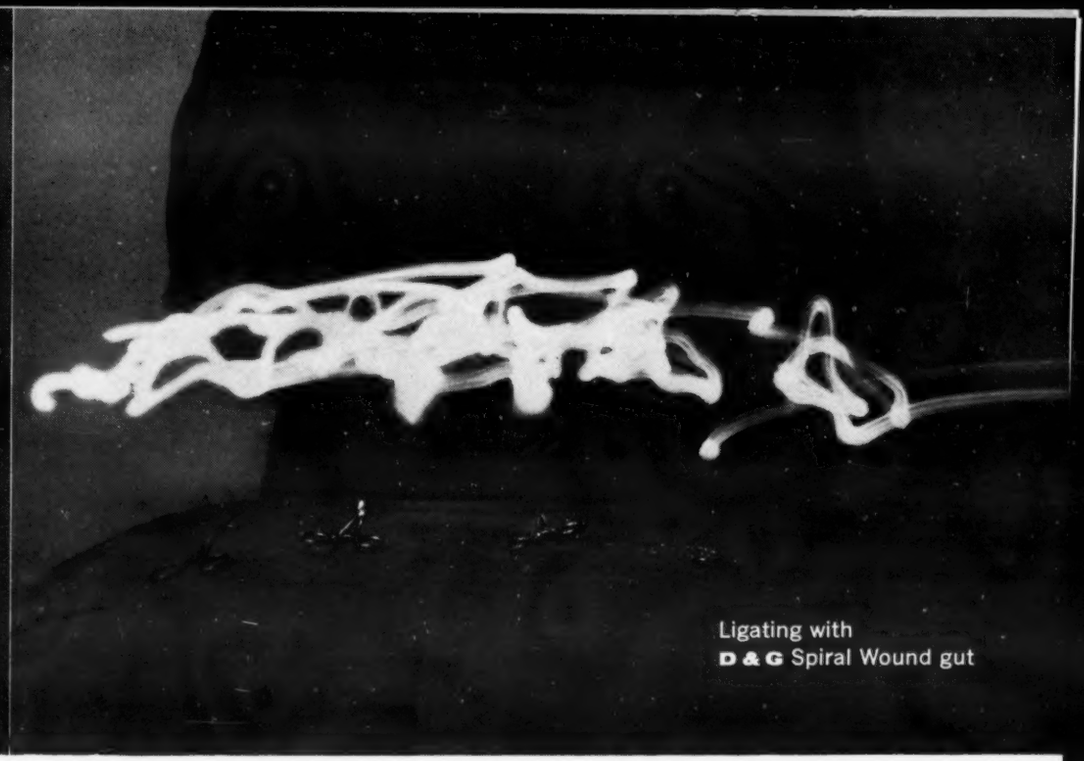


Ligating with
cut lengths



Ligating with
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Speed ligating time with **D&G** Spiral Wound gut

Light-tracings in these time-and-motion pictures record a surgeon's hands while he is ligating. Compare the smooth economy of motion when the surgeon uses 54 inches of Spiral Wound gut with the extra motions he uses reaching for additional cut lengths.

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D & G Spiral Wound saves you nurses' time too! It's ready to use right from the tube without winding, stretching, or any other handling.

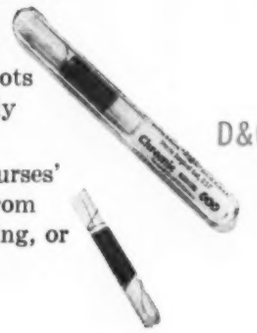

Photo technic: *light-tracings, made by attaching light bulbs to hands.*

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FURACIN® soluble dressing—antibacterial protection without retarding healing

- bactericidal to the majority of pathogens found in surface infections*
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For topical antibacterial therapy in: surgery • severe burns • skin grafting • ulcers • pyodermas • first aid treatment of abrasions, lacerations

*Shipley, E. R., and Dodd, M. C.: Surg., Gynec. & Obst. 84:366, 1947.

FORMULA: Furacin Soluble Dressing contains Furacin (brand of nitrofurazone) 0.2%, dissolved in a water-soluble, ointment-like base of polyethylene glycols.
SUPPLIED: 2 oz. tube; 4 oz., 1 lb. and 5 lb. jars.

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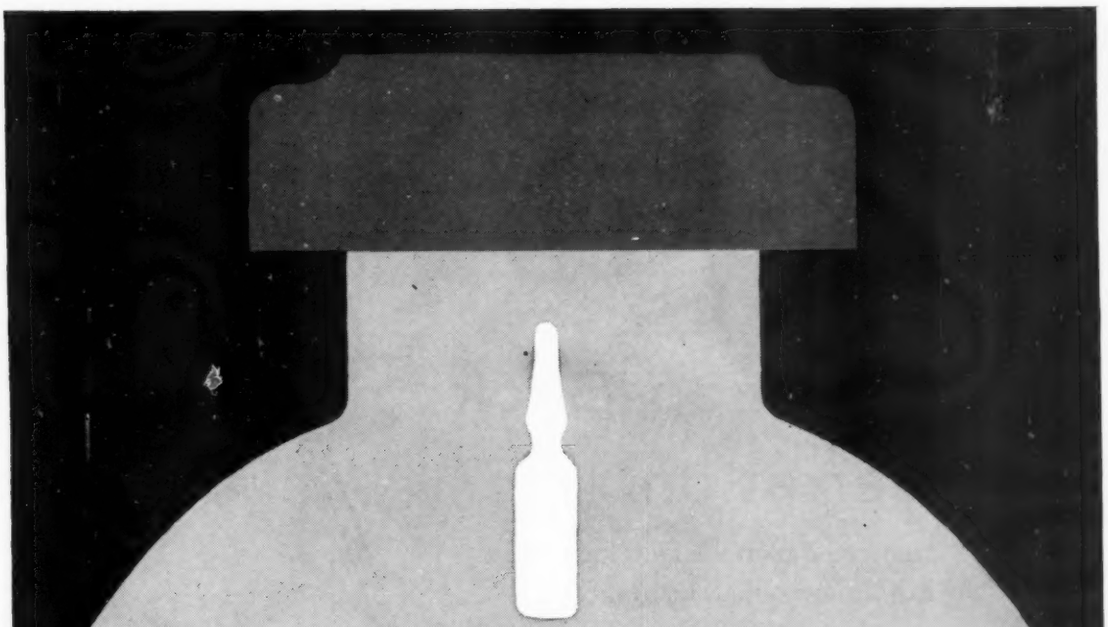

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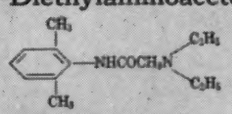
• **Duration** • **Clinical Effectiveness** • **Clinical Tolerance** • **Speed**
• **Stability** • **Versatility** • **Clinical Predictability** • **Safety** • **Depth**

Trade Name: XYLOCAINE **Generic Name:** lidocaine*

Chemical Name: α-Diethylaminoaceto-2,6-xylidide

Chemical Structure:



Potency: Two to three times that of procaine.

Duration of Action: Two to three times that of procaine.

Anesthetic Index: 1.8. **Surface Anesthetic Index:** 8.

Safety Factor: Two to three times that of procaine (because smaller concentrations and volumes are clinically as effective).

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Inhibition of Therapeutic Action of Sulfonamides or Antibiotics: None.

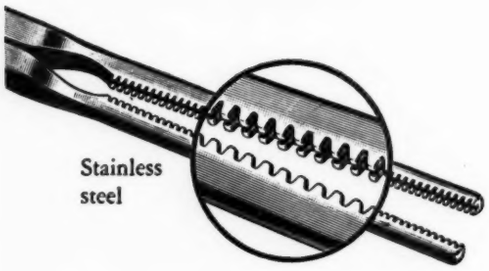
Versatility: Effective in local infiltration anesthesia; in major conduction anesthesia; in temporary therapeutic blocks for relief of pain; in topical anesthesia.

Available on Request: Descriptive literature, bibliography, and trial supply.

Supplied: Vials, 0.5%, 1% and 2% in 20 cc. and 50 cc. without and with epinephrine 1:100,000; 100 cc. vials, 1% without epinephrine. Ampoules, 2 cc., 2% without and with epinephrine 1:100,000.

Astra Pharmaceutical Products, Inc., Worcester 6, Mass.

*U. S. PATENT NO. 2,441,498



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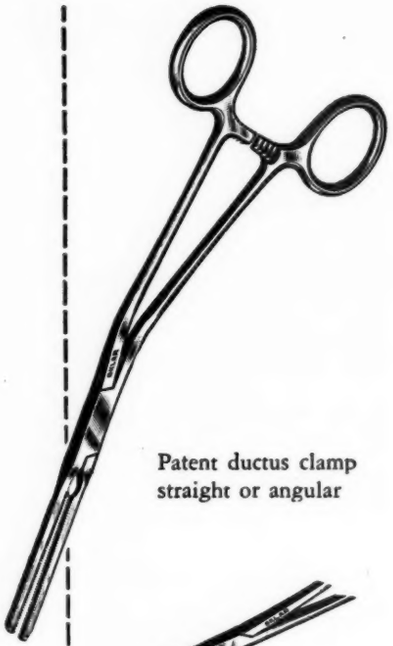
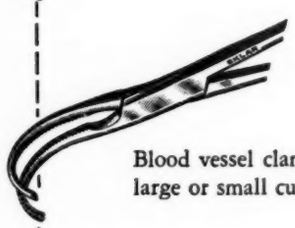


Patent ductus clamp
straight or angular

Satinsky
vena cava clamp



Blood vessel clamp
large or small curve

Coarctation clamp
straight or angular

Bronchus clamp, angular

Bulldog clamp
2", 2½" 3", 3½"

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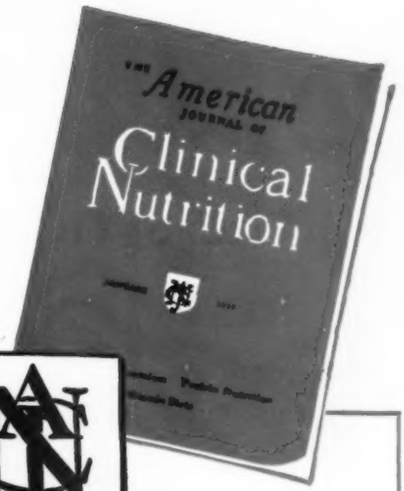

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id in the aorta and fastened with 4 to 6 sutures above and 3 sutures below a
each iliac vessel. The sutures are of 5-0 deknatel and are placed from the outside
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d out again through the arterial wall. These sutures are tied on the ou

ion on the upper surface of the pulmonary artery (Fig. 11). An anasto
formed between the end of the subclavian artery and the side of the pu
by the use of No. 00000 Deknatel sutures. The suture is one which eve
of the vessels. The procedure is rendered easier if the posterior sutu

The approximated edges of the middle 3 or 4 cm. were tightl
a continuous suture of 00000 Deknatel. After making sure
n of the tube was watertight we turned the tube inside out.
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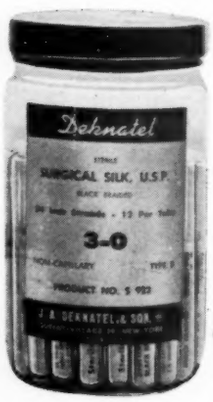

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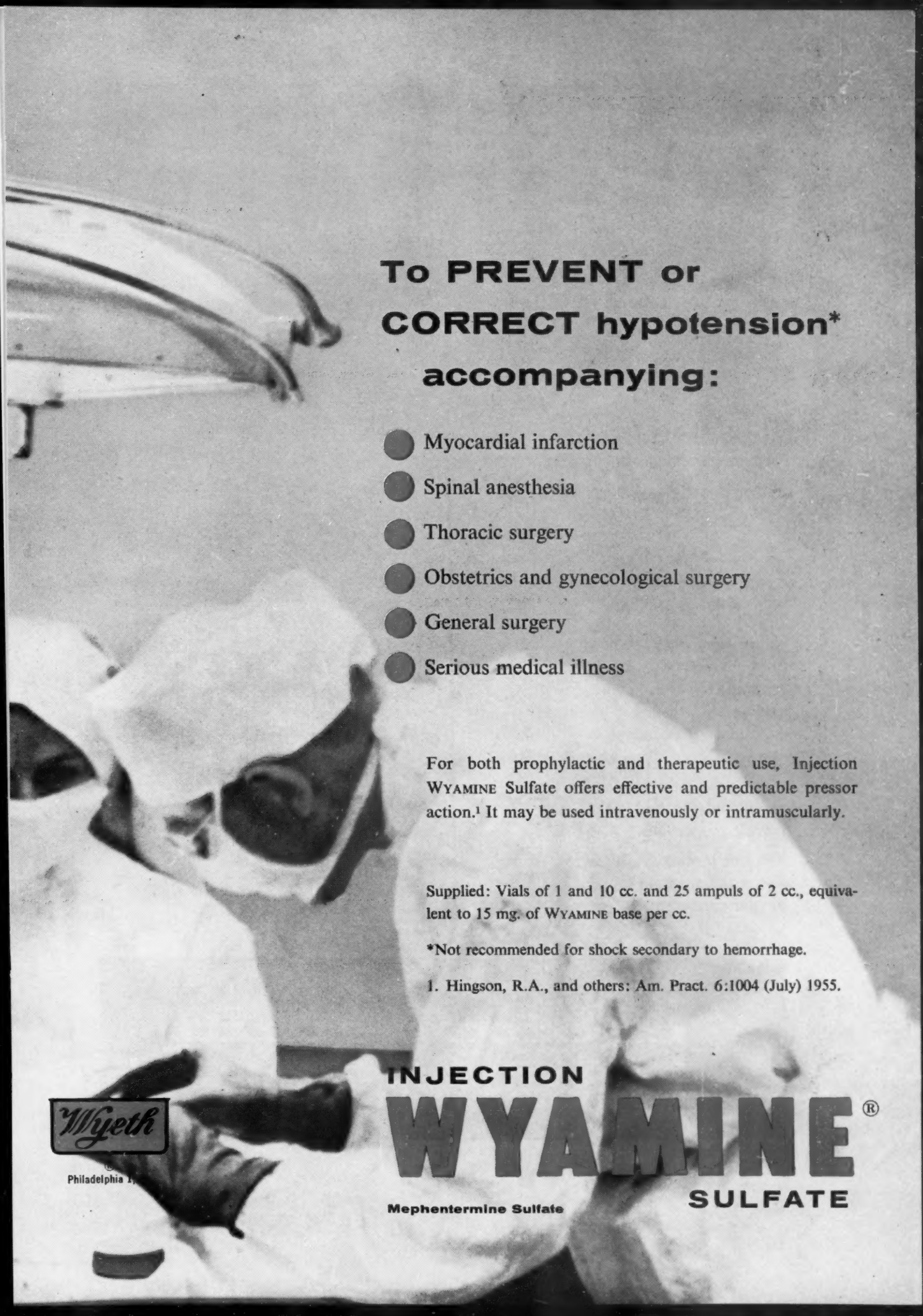
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1. Hingson, R.A., and others: Am. Pract. 6:1004 (July) 1955.
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(Critically essential L-lysine plus all the important vitamins)

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Thiamine Mononitrate	10 mg.
Riboflavin	10 mg.
Pyridoxine Hydrochloride	2 mg.
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Ascorbic Acid	300 mg.

**Equivalent to 600 mg. L-lysine*

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References: 1. Rhoads, J.E.: Internat. Abstr. Surg. *94*:417, 1952. 2. Mecray, P., Jr.: Am. J. Clin. Nutrition *3*:461, 1955. 3. Cannon, P.R.: J.A.M.A. *135*:1043, 1947. 4. Halpern, S.L., in Nutrition in Infections, Miner, R.W., ed.: Ann. New York Acad. Sc. *63*:147, 1955.

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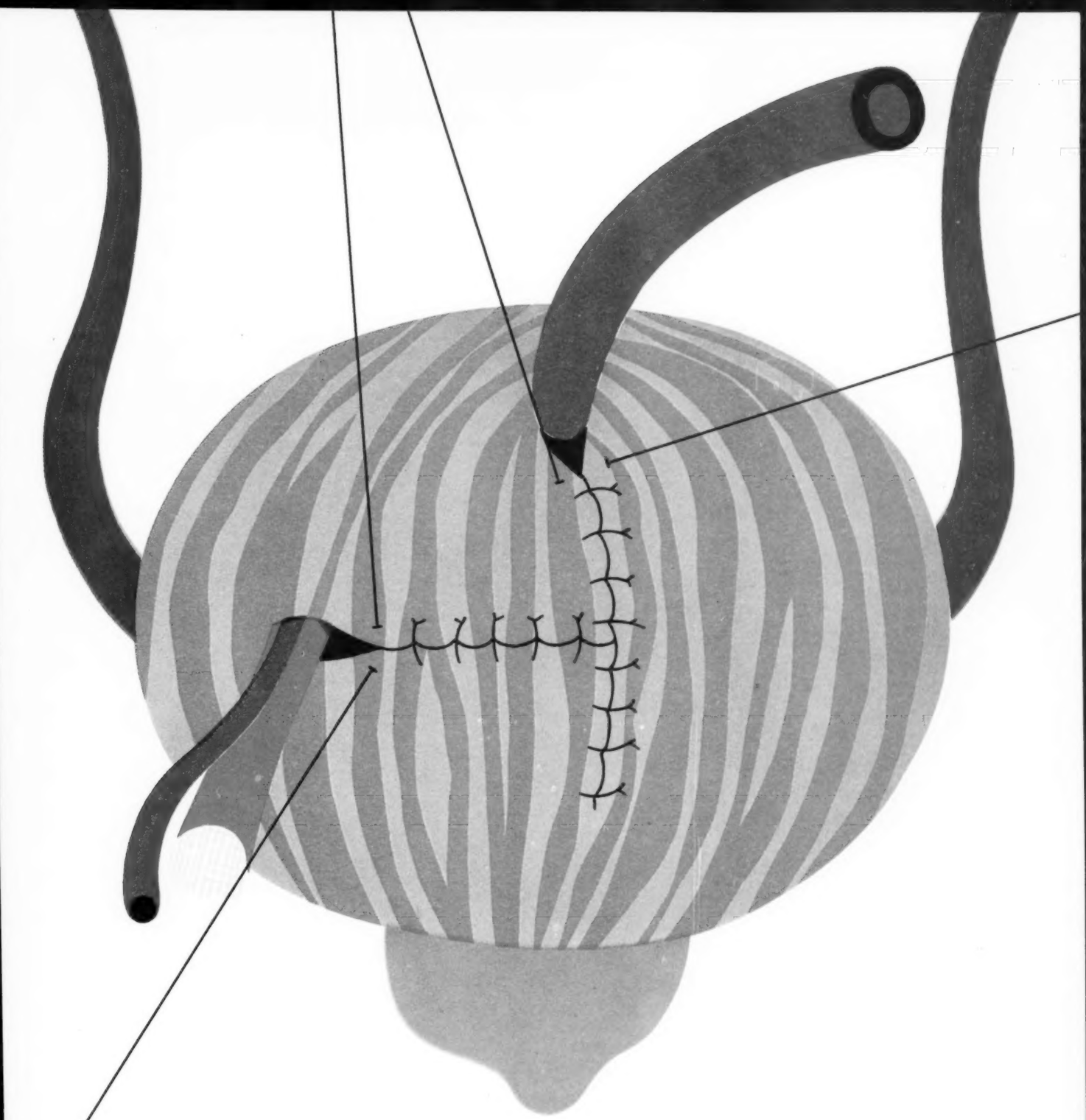

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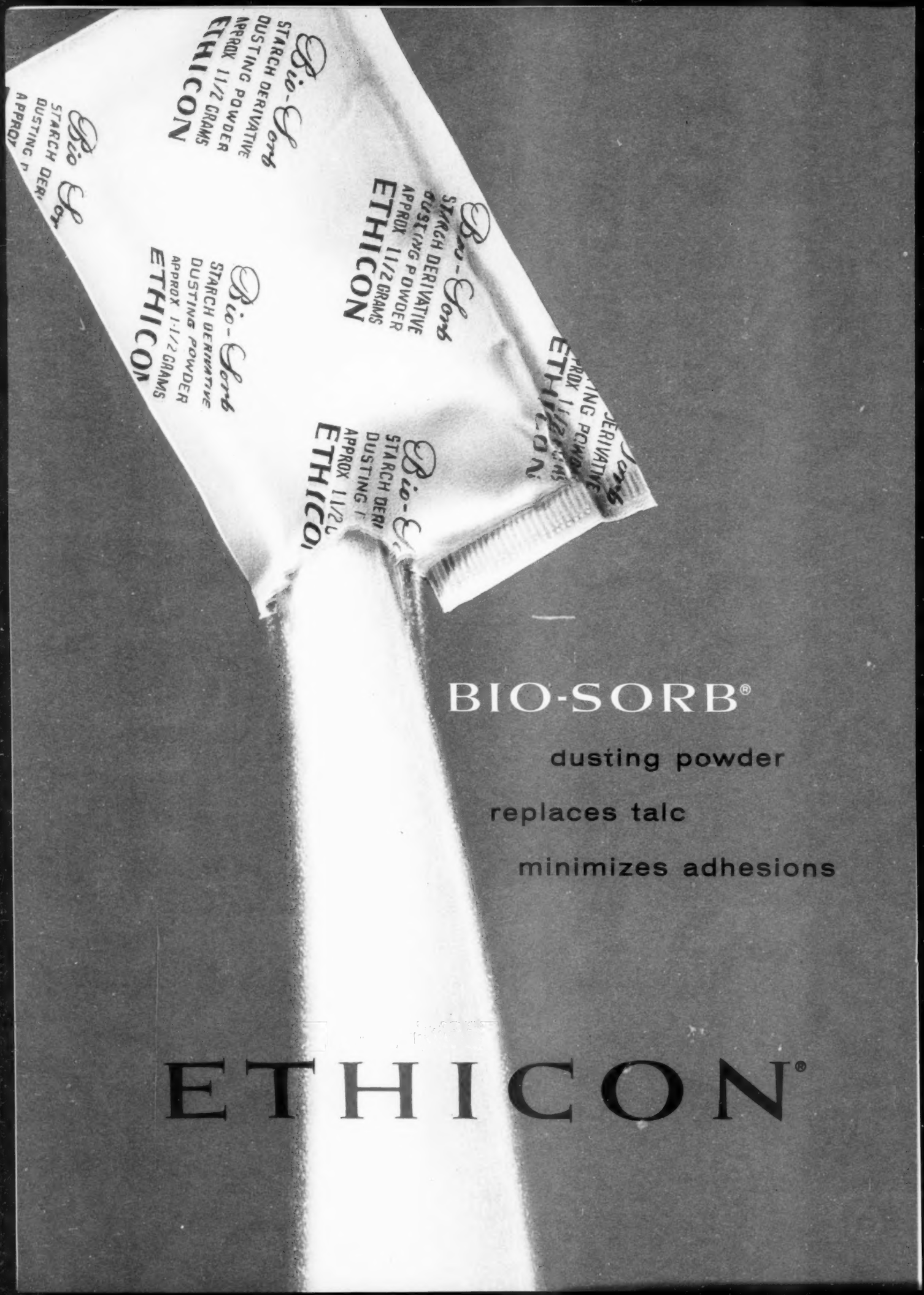
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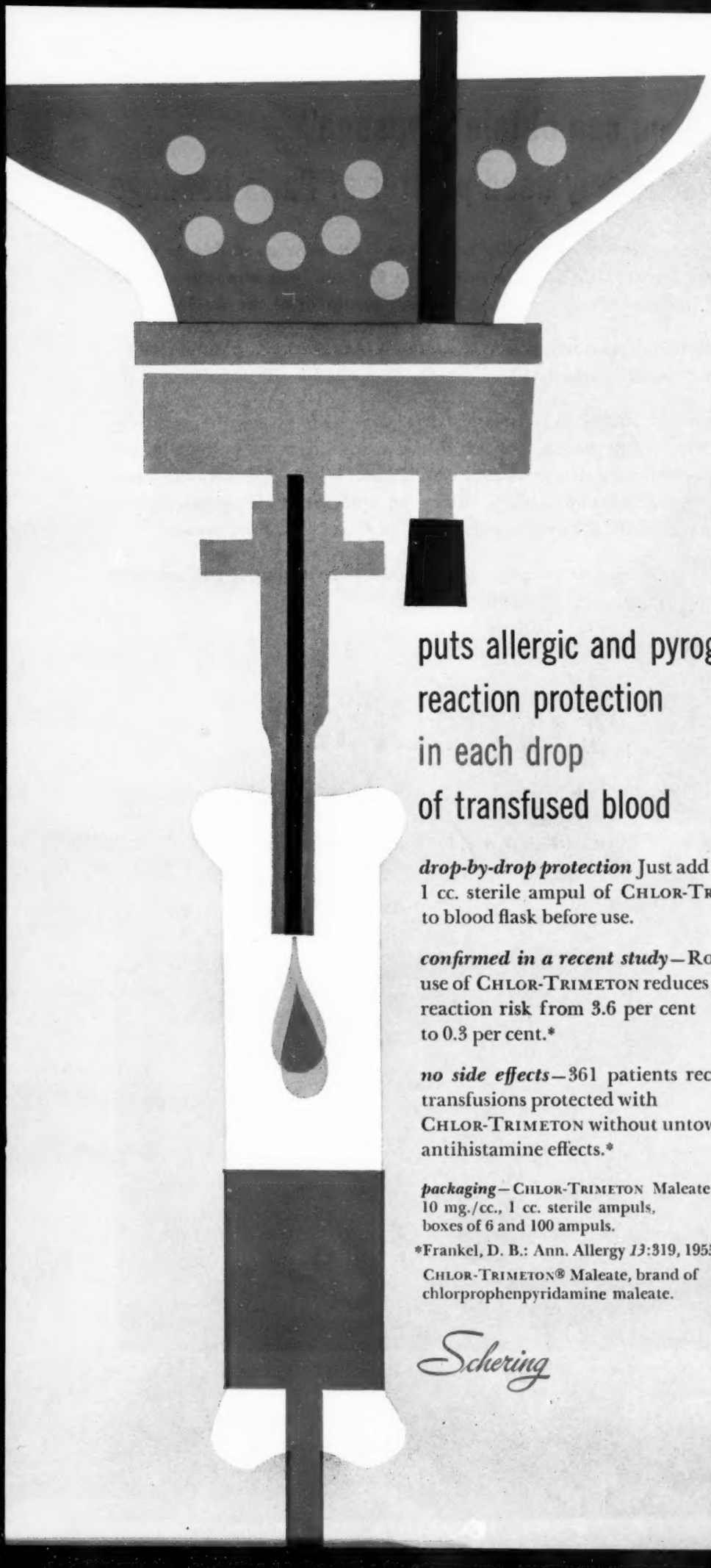

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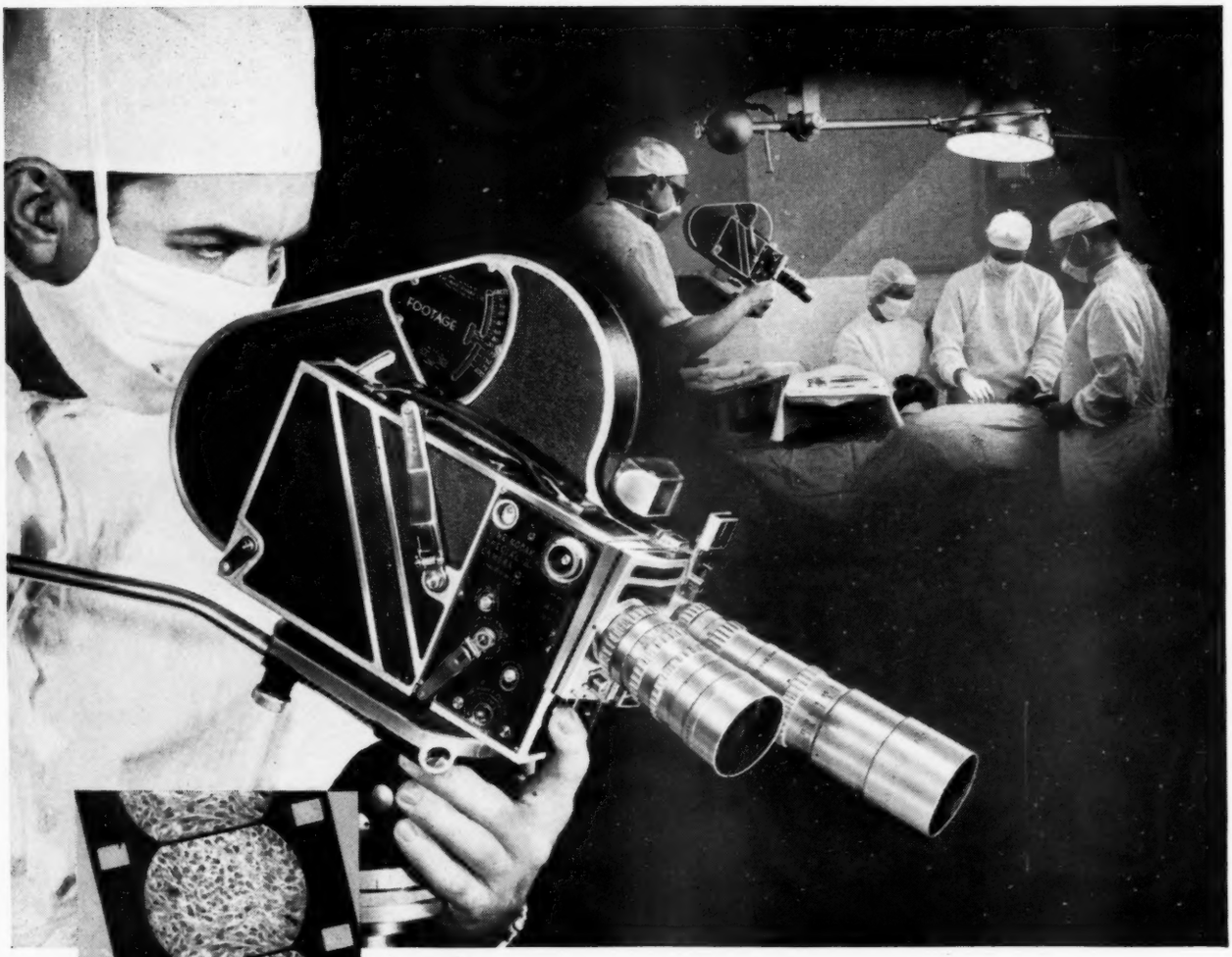

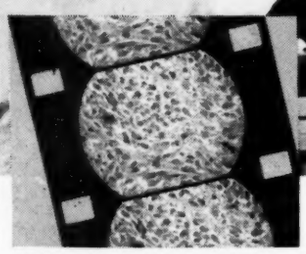

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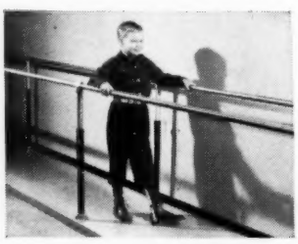

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References: 1. N.N.R. 1954, p. 107. 2. J.A.M.A. 153: 1516 (Dec. 26) 1953.

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1. Johnston, T. G., and Cazort, A. G.: J. Allergy 27:90, 1956. 2. Schwartz, E.: New York J. Med. 56:570, 1956. 3. Schiller, I. W., et al.: J. Allergy 27:96, 1956.

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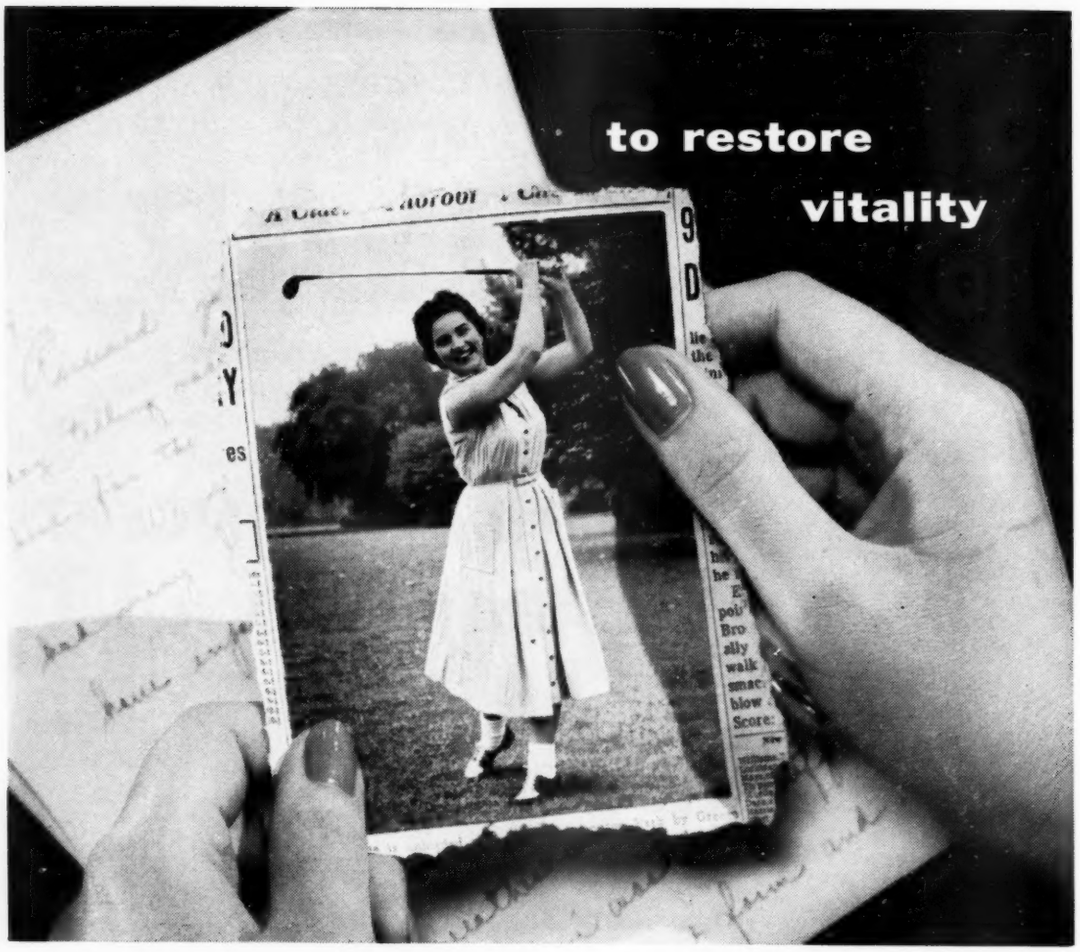

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The American Journal of Surgery

VOL. 91 JUNE 1956 NUMBER SIX

Editorial

NEUROLOGIC ASPECTS OF THE PAINFUL SHOULDER

PAIN in the shoulder and upper extremity of neurologic origin may result from intravertebral or extravertebral lesions. Pain of central origin caused by disorders of the thalamus or the sensory cerebral cortex is so rare that it may be dismissed without further attention at this time. Brachial neuritis, brachialgia and brachial neuralgia are all nonspecific terms applied to shoulder and arm pain. They are of no greater significance etiologically than "sciatica" or "sacroiliac" disease when applied to pain in a lower extremity.

It is well known that lesions of the nervous system which cause pain in an upper extremity are accompanied by such objective manifestations as atrophy and weakness of muscles, alterations in the tendon reflexes, fibrillations and more or less orderly sensory disturbances. In the presence of visceral disease with projection of pain to an upper extremity, such objective neurologic signs are not found.

Intravertebral lesions causing shoulder and arm pain compress or irritate one or more cervical posterior roots or involve the pain pathways in the spinal cord. The following are the most frequent intravertebral disorders associated with shoulder and arm pain: (1) cervical disc protrusion, (2) arthritic spurring, (3) tumor of the spinal cord and (4) syringomyelia.

The fact that protrusion of a cervical intervertebral disc is responsible for the largest proportion of shoulder pain of neurologic origin is a relatively recent discovery. While spinal cord pressure due to rupture of a cervical disc into the spinal canal had been observed, in 1943 Semmes and Murphy called attention to the syndrome of cervical disc protrusion with nerve root involvement alone. Patients with this disorder were often treated for angina pectoris, coronary thrombosis, arthritis, brachial plexus neuritis, neuralgia or bursitis before the correct diagnosis was established. Now that physicians are more generally aware of this condition, many patients with cervical disc protrusions are treated early and adequately.

The symptoms of cervical nerve root pressure due to a unilateral cervical disc protrusion may occur suddenly. Trauma frequently causes or precipitates a cervical disc protrusion. Sudden twisting of the neck or a sudden forward thrust followed by hyperextension, violent physical exertion during athletic feats and similar activities may be related by the patient to shoulder and upper extremity pain. Occasionally patients make no mention of any trauma, the symptoms apparently originating spontaneously, often during sleep. A stiff neck or a crick in the neck may be the first indication of this disorder, followed by pain radiating into the interscapular region, shoulder, arm, thumb and index or middle fingers in a matter of days or weeks. In some patients repeated attacks of stiff neck may precede other symptoms for several weeks or months. Coughing and sneezing usually intensify the pain. After the neck symptoms subside, a characteristic root compression syndrome appears with complaints of numbness and paresthesias in the thumb or index finger in addition to the pain. At this stage muscular weakness is noted. Headache may also be present during the course of cervical disc lesions, resulting from spasm of neck muscles attached to the squamous portion of the occipital bone.

The objective findings are general and focal, depending upon the location of the injured disc.

The general signs are spasm of the cervical muscles, pain on compression of the cervical spine, tenderness in the supraclavicular fossa and pain on movement of the cervical spine. Spasm of the scalenus anticus muscle frequently accompanies cervical disc lesions and the signs of such spasm may overshadow those due to the actual lesion.

Most cervical disc protrusions occur between C_5 and C6 or C6 and C_7. The sixth cervical nerve root is involved in C_5–C6 disc lesions. In these patients the biceps reflex is diminished or absent and flexion of the elbow is weak. Sensory disturbances involve mainly the thumb and index finger. In disc protrusions at C6–C_7 the seventh cervical root is involved; extension at the elbow is paretic and the triceps reflex is diminished or absent. Alterations in sensation involve mainly the middle finger.

X-rays of the cervical spine are of value in arriving at a diagnosis. The films disclose an alteration of the normal cervical curve, narrowing of the disc space and deformity of the intervertebral foramen in the oblique views. Myelography is used to confirm the clinical impression. As far as treatment is concerned, every patient should have an adequate trial of conservative therapy before myelography or surgery is contemplated. This consists of head traction, immobilization of the cervical spine and injections of procaine into the scalenus anticus muscle. Many patients improve with adequate non-surgical treatment. If the symptoms persist after six to eight weeks of conservative therapy, then myelography should be done. If the myelogram confirms the diagnosis, removal of the offending disc by partial laminectomy is the next step. The results of surgical treatment of cervical disc ruptures have been excellent.

Pain in the shoulder and arm may be due to arthritic spurs in the cervical vertebrae. There is evidence that hypertrophic spondylitis may be merely the end result of disorders of the intervertebral discs. The discs undergo degenerative changes consequent to the wear and tear of everyday life. Those sites in the vertebral column which are most mobile, that is the lower cervical and the lower lumbar, suffer most. Bony spurs and ridges cause root pressure similar to that produced by protrusions of soft disc material. Often a bony ridge and a soft disc protrusion coexist. The treatment of pain in the shoulder and arm due to laterally placed bony spurs and ridges is similar in all respects to that used for disc protrusions.

Tumors of the spinal cord involving the lower cervical spine may produce pain in the shoulder and arm. This is especially true of neurofibromas which often cause a clear radicular syndrome. It may be difficult to differentiate a neurofibroma from a laterally placed ruptured disc even with the use of myelography. In some cases the diagnosis is made only on surgical inspection. Extradural neoplasms and even metastatic tumors of the lower cervical vertebrae may give rise to pain in the shoulder and arm as the presenting symptom.

Syringomyelia may be associated with pain in the shoulder and arm. The findings in this disease (atrophy of muscles, dissociated sensory changes, scoliosis and trophic disturbances) are so typical that errors in diagnosis need rarely be made.

Of the many extravertebral neurologic disorders causing pain in the shoulder and arm the following deserve consideration: (1) Involvement of the lower cervical nerve roots just as they leave the intervertebral foramens either by neoplasms or traumatic injuries. (2) Tumors of the brachial plexus, both primary and metastatic (Hodgkin's disease infiltrating the brachial plexus falls into this category). (3) Pulmonary sulcus or Pancoast tumors arising in the upper thoracic inlet may cause severe pain in the shoulder and arm as the first symptom. Horner's syndrome and a dense shadow in the apex of the lung in the x-rays should lead to the correct diagnosis. (4) Cervical ribs and malformations of the first rib may compress the brachial plexus and give rise to pain in the shoulder and arm. With these lesions there is almost always associated vascular compression, so that in addition to pain in the shoulder girdle the patient complains of coldness and pallor of the extremity or marked edema if the subclavian vein is obstructed. (5) The scalenus anticus syndrome, that is, pain in the shoulder girdle radiating into the ulnar aspect of the forearm and hand, is no longer accepted as a primary clinical entity by most students of shoulder-arm pain. Spasm of the scalenus anticus, just as spasm of the erector spinae muscles in the lumbar region in lumbar lesions, accompanies nearly all disorders of the cervical spine, both intra- and

extravertebral. The presence of scalenus anticus spasm should lead to a search for its cause. This may be a ruptured cervical disc, a tumor of the spinal cord or irritation of the lower cervical nerve roots by any of the causes already mentioned. Occasionally, even after exhaustive study, the primary factor cannot be discovered and the diagnosis of a scalenus anticus syndrome remains.

Localized neuritis of the shoulder girdle is a disease of sudden onset which begins with severe pain in various regions about the shoulder. There is usually no systemic reaction. Within a few days weakness and atrophy of the shoulder girdle muscles develop. The muscles most often involved are the serratus magnus, supra- and infraspinatus, deltoid and trapezius. Others deriving their nerve supply from the same root may be spared. Thus it is concluded that the lesion affects peripheral nerves. Cases reported during the war years were designated as "pack palsy." The symptoms sometimes follow surgical procedures performed under general anesthesia.

Herpes zoster of the shoulder and arm may be followed by post-herpetic intractable pain.

The shoulder-hand syndrome, also known as reflex dystrophy of the upper extremity, deserves special consideration. Dr. Otto Steinbrocker of this city has been interested in this disorder for the past several years and he has reported his observations in several informative publications. Following coronary occlusion, hemiplegia, trauma, arthritis or occasionally arising spontaneously without a known provocative cause, severe burning pain in the shoulder and upper extremity along with vasomotor and trophic disturbances develop. Steinbrocker and his associates believe that although the inciting factor in the shoulder-hand syndrome may differ from patient to patient, the underlying neurophysiologic mechanisms involved are similar, if not identical. The favorable response to interruption of sympathetic impulses by stellate ganglion or paravertebral block would appear to favor such hypothesis.

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SCIENTIFIC PAPERS

Pulmonary Arteriovenous Aneurysm

A REPORT OF SIX CASES

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PULMONARY arteriovenous aneurysm seems certain to lose its identity as a rare disease. Smith and Horton[9] were the first to diagnose the lesion clinically. Ten years later, Yater, Finnegan and Giffin[11] reviewed forty-one cases of pulmonary arteriovenous aneurysm and included two additional new cases of their own and two unreported cases of Blades. Muri[6] analyzed eighty cases, including one of his own; two years later his review[7] numbered 117 cases, all reported in the literature before 1954. Stringer et al.,[10] from personal correspondence during this same period, have enlarged the number to 148 cases. In the interim one is impressed with the marked increase of isolated reports, especially in the foreign literature. It would appear that this lesion has merely awaited the exposure of time to achieve commonplace recognition.

GENERAL CONSIDERATIONS

Most writers on the subject agree that pulmonary arteriovenous aneurysm is probably a congenital lesion and one which may be hereditary. In fact, it may well represent the pulmonary variant of hereditary hemorrhagic telangiectasia (Rendu-Osler-Weber's disease). In the past a variety of names has been given the lesion, but the recent trend to classify it more precisely and to reject equivocal terminology is commendable. The terms, arteriovenous fistula or aneurysm, seem interchangeable and ingrained in the literature. However, Lindgren[4] suggests that fistula be reserved for the rare, traumatic, pulmonary vascular shunt and aneurysm for the congenital shunt. The terms angioma, hemangioma and cavernous hemangioma of the lung would then designate the true pulmonary neoplasm. As indicated by Muri,[7] this terminology seems to be gaining in favor and general acceptance.

Pulmonary arteriovenous aneurysm represents a shunt in most instances between a pulmonary artery and vein. Less frequently a systemic artery such as a bronchial vessel or branch from the aorta may "feed" the aneurysmal sac. Although the lesion may vary markedly in size, usually it is thin-walled with a tortuous lumen; frequently it may be impregnated with mural thrombi. Single or multiple vessels may "feed" or "drain" the shunt.

Unoxygenated blood, therefore, by-passes the pulmonary capillaries and subnormal arterial oxygenation results, the degree being determined by the functional size of the shunt. The secondary polycythemia of hypoxia with increased cell volume but normal plasma volume is similarly proportionate to the functional capacity of the by-pass mechanism. In contrast to a systemic arteriovenous shunt, the cardiac dynamics are probably little disturbed unless the shunt is extreme.

CLINICAL FINDINGS

The diagnosis is usually established in the young adult, although it has been made at either age extreme. Roberts and Hutchison[8] established an x-ray diagnosis in a sixty-six year old patient and Bowers[2] reported the lesion in the newborn. The common symptoms and signs include (1) dyspnea, (2) cyanosis and (3) clubbing of the digits, (4) nervous aberrations, (5) chest pain, (6) hemoptysis, (7) epistaxis, (8) telangiectases of the integument and mucous membranes, (9) murmur, and occasionally (10) thrill overlying the aneurysm.

Certain of these findings relate, therefore, to hypoxia and others to the mechanics of the lesion itself. If for any reason anemia is present (e.g., hemorrhage) the cyanosis may be masked; during a hemorrhage-free period, however, cyanosis may become readily evident.[1] Nervousness, transient unilateral weakness, aphasia, syncope, vertigo and convulsions are ascribed to cerebral disturbances from hypoxemia or small emboli. Paradoxic emboli may account for hemiplegia and death.

Although a blowing murmur heard over the lesion may be continuous, it is usually systolic and its amplitude augmented by deep inspiration. At times, differentiation from an intrinsic cardiac murmur may be difficult.[1] Hypertension, if present, is secondary to other causes. Although hepato- and splenomegaly have been reported in association with pulmonary arteriovenous aneurysm, these findings seem only unusually related.

LABORATORY AND X-RAY FINDINGS

The patient with cyanosis demonstrates a high erythrocyte count and hemoglobin content from the stimulation of the bone marrow by chronic hypoxia. The leukocyte count and the bleeding and coagulation times are normal. The circulation time varies with the prominence of two factors, each of which may offset the trend of the other to effect a normal test. For example, a large pulmonary artery-to-vein shunt will shorten the circulation time but this can be counterbalanced by increased blood viscosity. The electrocardiogram is frequently normal although tracings with right or left heart deviation may be detected should the cardiac output be increased. Arterial oxygen saturation is below the normal of 93 to 99 per cent.

Diagnosis often can be made from the x-ray appearance alone. A rounded, dense shadow connected to the hilum by a broad, vascular band is significant. Most of these lesions are seen in the middle, lingular or lower divisions of the lung, and multiple lesions are demonstrable in more than 50 per cent of these patients.

Other x-ray studies which aid in diagnosis include fluoroscopy for pulsation of the shadow, the Valsalva and Müller tests for change in size of the lesion, and tomography. The latter study is invaluable in the diagnosis of any localized pulmonary lesion. That it is not more readily available for general use is unfortunate.

For the definite establishment of the diagnosis preoperatively, angiocardiography should be employed. Not only can one evaluate the known lesion or lesions as seen in the ordinary x-ray but also one may detect shunts otherwise unrecognizable. To be of any significance, however, the films of angiocardiography must include the entire chest. Certainly, a surgeon is more confident of localizing and removing all shunts if adequate angiocardiography is available preoperatively. It is recognized that this study is not without its own mortality, especially in the young child with cyanosis,[3] but in competent hands when a single study is completely satisfactory the risk to the patient facing surgery is warranted.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis includes the following conditions: (1) congenital heart disease, usually of the cyanotic type, (2) pulmonary tuberculosis and tuberculoma, (3) neoplasm, (4) atelectasis, (5) bronchiectasis, (6) polycythemia rubra vera and (7) aneurysm of the pulmonary artery. In a child or young adult the findings of dyspnea, cyanosis, clubbing of the fingers and polycythemia are compatible with cyanotic congenital heart disease, but opposed are the concomitant findings of a heart normal in size and shape, the absence of a cardiac murmur and the x-ray findings of a density in the lung with vascular connections near the hilum. Clubbing and secondary polycythemia are not characteristic in pulmonary tuberculosis nor is the tuberculous lesion seen on x-ray similar to that usually seen in pulmonary arteriovenous aneurysm. Hemoptysis is common to both. Similarly, hemoptysis and clubbing are compatible with a diagnosis of bronchiectasis; although a fluid-filled, bronchiectatic pocket might easily simulate the x-ray density of a pulmonary shunt, yet the sputum changes are absent in the latter.

The patient with polycythemia vera is usually older and will show immature leukocytes and basophilia. Splenomegaly is more common, but clubbing is not seen. The x-ray densities which may be seen in polycythemia vera are atypical of a shunt and will change or disappear in a few weeks. A patient with an aneurysm of a pulmonary artery might be dyspneic and demonstrate cyanosis, clubbing

and polycythemia, but the density on x-ray is connected to the mediastinum rather than to the hilum and invariably will pulsate. However, angiocardiography alone may differentiate the two conditions.

TREATMENT

Maximum curability is attained by surgical excision of the lesion, accomplished preferentially by local or limited resection, lobectomy or pneumonectomy. Ligation of the feeder vessel is not the rational treatment of choice.

Crystallized indications for surgery stem from the symptoms associated with hypoxia, and hemoptysis. The latter may occur, in alarming or fatal proportion, before polycythemia, cyanosis and clubbing develop. It is the asymptomatic patient with pulmonary arteriovenous aneurysm who presents a problem of management. These patients usually are observed and are operated upon only if the physiologic alterations of a right-to-left shunt develop. During this period of observation it is recognized that the development and progression of symptoms is not infrequent. Moreover, the threat of pulmonary hemorrhage or hemothorax from rupture, paradoxic cerebral emboli and brain abscess is ever present in the asymptomatic patient.

The teaching of Lindskog et al.[5] merits attention. They believe that the asymptomatic existence of a pulmonary arteriovenous aneurysm is sufficient evidence in itself for advising surgery, unless the patient has some forbidding unrelated contradication. Their conclusion is based upon the significant danger of serious or lethal hemoptysis and hemothorax.

A second problem of management is related to the frequent multiplicity of the lesion. Because of this, conservative local resection of a pulmonary shunt is desirable. Careful dissection may forestall extensive resection of the lung and permit the removal of multiple lesions. Preoperatively, angiocardiography may dictate the conservative surgical approach if multiple lesions are present.

As in cyanotic heart disease, the patient with marked cyanosis and polycythemia from an arteriovenous aneurysm presents certain hazards during surgery. Maximum oxygenation and, if possible, the avoidance of blood transfusion during surgery is necessary to curtail the complications of anoxemia and thrombosis.

During thoracotomy the lung should be examined carefully for the presence of multiple shunts. Aneurysms near the pleural surface may be readily visualized; if they are deep-seated, a palpable thrill may disclose their presence. To facilitate detection of the deeply buried, non-visible shunt, the use of a sterile stethoscope applied to the lung is a simple but effectual expedient to disclose a characteristic bruit.

In the immediate postoperative period frequent checks of the hematocrit and erythrocyte count are indicated and commensurate, corrective measures should be employed if these studies are significantly elevated.

The persistence, or subsequent development, of cyanosis or subnormal arterial oxygenation of any degree indicates that an arteriovenous shunt is still functioning physiologically. When the shunt is detected, and if adequate pulmonary function has been preserved after initial surgery, then re-exploration for cure is feasible.

A review of the records of Firland Sanatorium, the King County Hospital and the Children's Orthopedic Hospital, Seattle, has uncovered the following six unreported cases, three of which were proved by surgery.

CASE REPORTS

CASE 1. L. R., a thirty-six year old white man, was admitted to Firland Sanatorium for the first time on January 24, 1949, following a severe episode of hemoptysis. Seventeen years earlier, in 1932, an x-ray diagnosis of tuberculoma of the left lung had been made. In the past he had experienced a mild, transient, cerebrovascular accident, epistaxis and hemoptysis, intestinal hemorrhage, and increasing dyspnea and fatigue. Positive abnormal findings on this admission included cyanosis, clubbing and telangiectasis of the skin of the face and neck. The heart, lungs and abdomen were normal. No murmurs or chest bruit were heard.

Laboratory data revealed the following: red cell count, 5,500,000; hemoglobin, 15.6; hematocrit, 5.3; leukocyte count, normal; sedimentation rate, 3 mm./hour; urinalysis, normal; bleeding and clotting time, normal; arm-to-tongue circulation time, 10 seconds; sputum, gastric and urine studies for tuberculosis, negative. Chest x-ray showed a fairly sharply circumscribed, rounded density connected to the hilum by a broad band and lying anteriorly in the left lower lung field. The dense

mass pulsated on fluoroscopy. A diagnosis of familial telangiectasia with pulmonary arteriovenous aneurysm was made and the patient was transferred to the King County Hospital for surgery. At thoracotomy on January 27, 1949, a typical, single, saccular dilatation, approximately 2.5 cm. in diameter, representing an arteriovenous aneurysm was found in the left upper lobe. The lesion was removed successfully by lobectomy. At the time of writing, more than six years after surgery, the patient remains asymptomatic and in excellent health. Annual x-rays of the chest do not reveal any significant findings.

CASE II. H. B., a forty-seven year old white man, was first admitted to Firland Sanatorium in February, 1949, with a long history of hemoptysis, cough and chest pain. At the age of eighteen he had begun to have intermittent episodes of exertional pain in the left chest lasting from 15 to 20 minutes. In 1920 and intermittently thereafter, he had experienced episodes of hemoptysis; one prolonged episode was associated with trauma to the left lower chest. An x-ray in 1940 had showed "some pathology" although no diagnosis was made. In 1942 he had been hospitalized in a sanatorium although no diagnosis of tuberculosis was established. By 1942, in addition to hemoptysis, episodes of increasing exertional dyspnea, cyanosis, severe epistaxis, nervousness and irritability were present. During this period multiple sputum examinations for tuberculosis and fungus had given negative results. The family history, including parents and siblings, was not remarkable. One of five children, however, was noted to have frequent nosebleeds and at least one episode of hemoptysis (compare with Case IV).

Examination revealed cyanosis, clubbing of the fingers and toes, telangiectasis of the nose and lower lips, and thrombosis of the superficial leg veins. The heart and lungs were normal except for a late, systolic, blowing murmur low in the left axilla, most intense during inspiration and almost inaudible during expiration. Laboratory data revealed the following: hemoglobin, 14.6; hematocrit, 50; sedimentation rate, 3 mm./hour; leukocyte count, bleeding and clotting time, and urinalysis, normal; electrocardiogram revealed slight right ventricular preponderance.

X-ray of the chest was interpreted as showing two small densities in the right lung field and a similar large shadow in the lingula, all compatible with pulmonary arteriovenous aneurysms. (Fig. 1.)

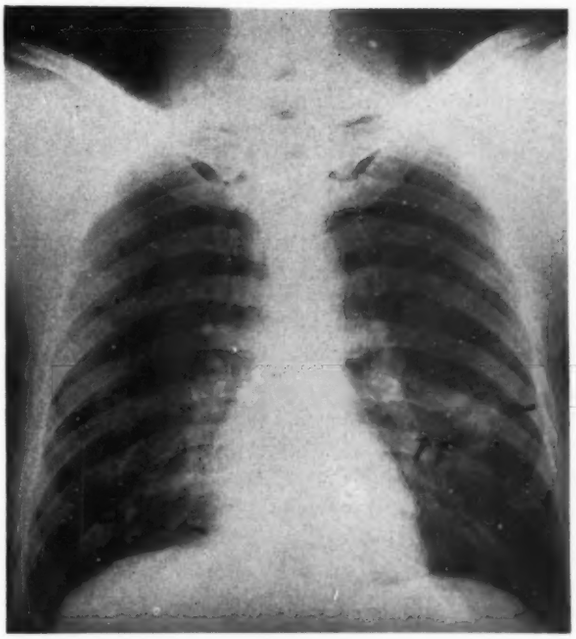

FIG. 1. Case II. Anteroposterior view of chest of patient H. B. Within the left fourth interspace there is an irregular density with a connecting band to the hilar vessels. It represents an arteriovenous aneurysm and was removed by lingulectomy. Note the smaller densities in the right lower lung field.

It was believed that the source of the hemoptysis was the large aneurysm on the left, and on April 14, 1949, the left chest was opened. A pulsating aneurysm, 4 cm. in diameter, was found in the lingula. Palpation and auscultation with a sterile stethoscope revealed no other shunts, and lingulectomy was performed.

His convalescence was uncomplicated. On discharge to private care elsewhere, there was marked but not complete improvement of the cyanosis and dyspnea. Postoperative x-rays were believed to demonstrate a slight increase in size of one of the densities in the right lower lung field. The hemoglobin remained at 15.6 gm. per cent, hematocrit 56, and red cell count 5,140,000.

Subsequent history was obtained by letter from the patient's private physician. In addition, the patient consulted a physician of the Firland staff four months after surgery because of severe hemoptysis. At that time his chest was normal on examination. X-ray demonstrated little change in the size of the lesions

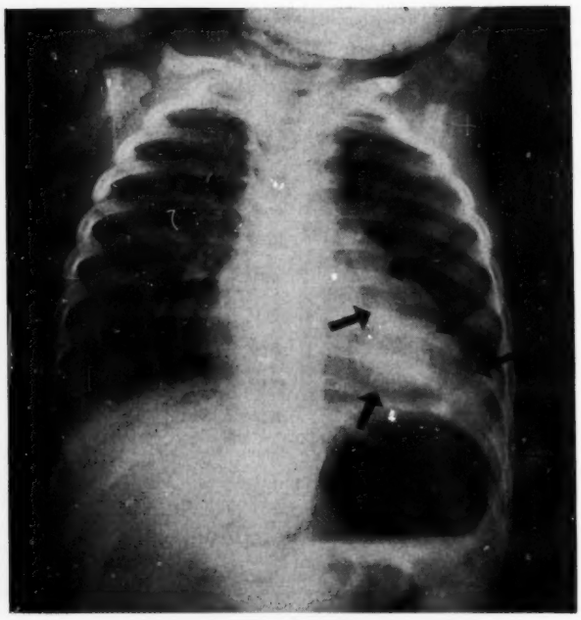

FIG. 2. Case III. Anteroposterior view of chest of patient T. J. The dumbbell-shaped density and connecting hilar band is outlined in the left lower lung field. It was a large arteriovenous aneurysm and was removed by left lower lobectomy.

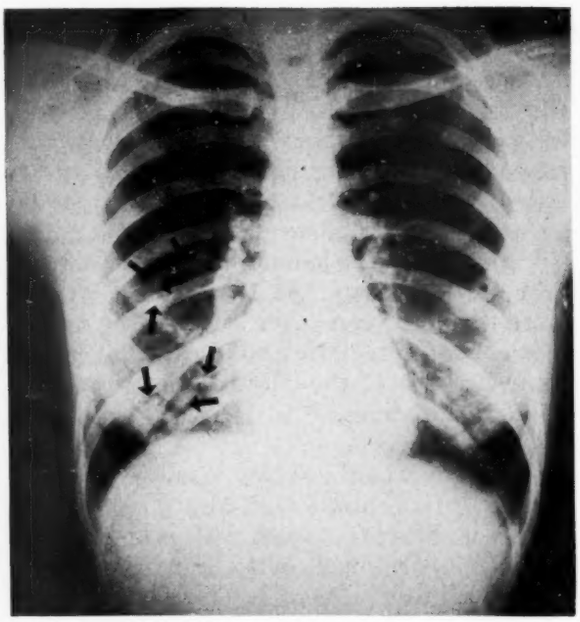

FIG. 3. Case IV. Anteroposterior view of chest of patient E. V. Note the two outlined densities in the right lung field. These are interpreted as compatible with attested arteriovenous aneurysms. Support of the diagnosis is further attested by the familial relationship and the history of hemoptysis.

of the right lung; the shadows were, however, more prominent than on the initial sanatorium films. In March, 1955, coma and left hemiplegia suddenly developed and the patient died soon after. Several distressing episodes of hemoptysis had occurred during the year preceding death. No autopsy was performed.

CASE III. T. J., an eighteen month old white boy, was admitted to the Children's Orthopedic Hospital for the first time on November 26, 1954. Two weeks prior to admission an upper respiratory infection had developed associated with listlessness, irritability, fever, anemia, and generalized shotty lymphadenopathy and mild cyanosis. The birth and developmental history were normal. The family history was not significant, except that. the patient's mother had frequent nosebleeds.

The child was acutely ill. Suggestion of clubbing was noted by several examiners. The heart was not enlarged but a soft, grade 1, aortic, systolic murmur was audible. No chest bruit was heard during the early hospital period, but later one became apparent and was heard best low in the left axilla. Laboratory data revealed the following: hemoglobin, 10.0; red cell count, 6,670,000; hematocrit, 3.3; sedimentation rate, 1 mm./hour; urinalysis, normal; arterial O_2 saturation, 88 per cent.

X-ray showed a heart of normal size with an ovoid, dumbbell-shaped density at the left base without expansile pulsation during fluoroscopy. (Fig. 2.) The left chest was explored on December 15, 1954. A typical large arteriovenous aneurysm of the left lower lobe was found and removed by lobectomy. A small aneurysm was also removed from the lingula by wedge resection. The postoperative course was uncomplicated, and with complete disappearance of the cyanosis, the patient was discharged to clinic care on December 22, 1954.

CASE IV. E. V., a white married woman living in Montana, is the daughter of patient H. B. (Case II). During a visit with her father at Firland Sanatorium an x-ray of her chest was taken by an alert staff physician because of her history of epistaxis and hemoptysis, as given by the father. This x-ray demonstrated two round densities in the right lung field which were interpreted as typical of arteriovenous aneurysms. (Fig. 3.) Her family physician in Montana was advised regarding this finding and its familial relationship and hazards.

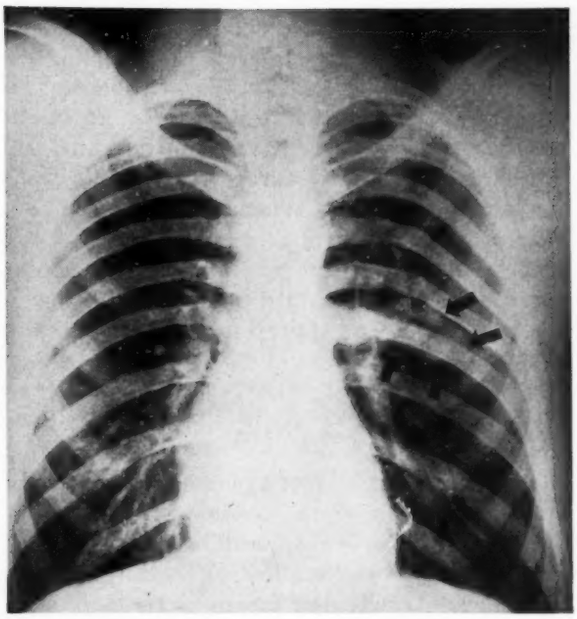

FIG. 4. Case v. Anteroposterior view of chest of patient R. G. The density in the left second and third interspaces was first discovered on a routine chest film. It led to the referral of this asymptomatic seventeen year old white boy to Firland Sanatorium where a diagnosis of pulmonary arteriovenous aneurysm was made.

FIG. 5. Case v. Tomogram of chest of patient R. G. Note the serpentine vascular channel outlined in this laminagraphic view of the left hemithorax.

CASE V. R. G., a seventeen year old asymptomatic white boy, was admitted to Firland Sanatorium for the first time on February 28, 1955, as an out-of-county referral with a tentative diagnosis of pulmonary tuberculosis. An x-ray density in the left lung by stereographic chest films (Fig. 4), by tomograms (Fig. 5) and by fluoroscopy was believed to be typical of a pulmonary arteriovenous aneurysm. An unexplained eosinophilia of 8 per cent was present but tuberculosis was ruled out. The patient was discharged on March 10, 1955, and referred to his private physician for further care.

CASE VI. C. A., a sixty year old white man, presented a history of recurring, severe epistaxis since childhood for which he was admitted to the King County Hospital for the first time on April 6, 1955. In 1947, after a routine chest film, he was told of the presence of an x-ray density in the left lung. Since 1947 he has required five blood transfusions because of anemia from severe nosebleeds; there has been no other form of bleeding. The family history is significant in that four close relatives have cutaneous telangiectases.

Examination revealed a pale, elderly man with obvious multiple cutaneous and oral telangiectases; a continuous chest bruit accentuated on systole and changing with breathing, heard best low in the left axilla; and a heart slightly enlarged to the left with a grade 2 systolic basal murmur.

Laboratory data revealed the following: red cell count, 3,600,000; hemoglobin, 7.3; hematocrit, 25; sedimentation rate, bleeding and clotting times, circulation time and venous pressure, normal. Arterial oxygen saturation (femoral) was 77 per cent (normal, 93 per cent).

X-ray demonstrated a smooth, sharply demarcated lobular density at the left base with a connecting channel to the hilum. The lesion was pulsatile on fluoroscopy. The patient was not given blood transfusions but an effort was made to increase his iron stores by the administration of intravenous and oral iron. The consensus of the chest conference at the King County Hospital was that surgery was not indicated at this time. It was recommended that after correction of his anemia, further studies relative to cardiac output and arteriovenous oxygen difference, including angiocardiography, should be done. The patient would then be reviewed again for surgery. He was discharged to clinic care on April 21, 1955.

Addendum: We know of three additional cases in which the diagnosis of pulmonary arteriovenous aneurysm has been established, but without the benefit of angiocardiography or surgery. Because of extenuating circumstances two of these patients could not be subjected to complete diagnostic work-up at Firland Sanatorium. The third is under observation at the King County Hospital.

COMMENTS

Case I demonstrates the slow but inexorable progression of symptoms of a pulmonary arteriovenous aneurysm. These symptoms began at an early age. Although intriguing, it is difficult to incriminate gastrointestinal telangiectasis as the cause for bleeding from the gut, particularly as there has never been a recurrence since removal of the pulmonary lesion. Excision of the lesion has effected a cure now more than six years in duration.

The patient in Case II also experienced the onset of symptoms near the age of puberty. The symptoms were progressive, and despite surgical intervention during which the largest lesion was removed, severe hemoptysis recurred. Without autopsy study one cannot unequivocally ascribe the cause of death as an embolus secondary to persistent pulmonary arteriovenous aneurysm but circumstantial factors cannot but strongly motivate such an opinion.

Case III is interesting in that early in the patient's hospital course, the correct diagnosis had been considered but was not high on the differential list. When one examiner definitely decided from the clinical and x-ray findings that the correct diagnosis was pulmonary arteriovenous aneurysm, and immediately thereafter when a chest bruit was heard, there was no further hesitation regarding the need for exploration. The contention that one must first think of the possibility of this lesion when there are abnormal x-ray densities is thus supported. Angiocardiography was not done preoperatively. The follow-up period as yet is too short for opinion regarding long-term prognosis.

The diagnosis of pulmonary arteriovenous aneurysm in Cases IV, V and VI, although not established by angiocardiography or surgery, seems reasonably justified. In Case IV the familial occurrence and the symptoms of epistaxis (and probable hemoptysis) lend support to the x-ray diagnosis. In Case V the appearance of the lesion on tomograms is striking. There would appear to be no doubt that the patient in Case VI requires additional study and eventually surgery. The indications for surgery in Cases IV and V are present according to the tenets of Lindskog et al.[5] We agree that from a prophylactic viewpoint there is more to be gained by careful diagnostic study followed by appropriate surgery in this type of patient.

SUMMARY

The diagnosis and management of pulmonary arteriovenous aneurysm is dealt with briefly. A total of six cases are presented, three patients with the diagnosis established by surgery and three patients with the diagnosis strongly supported by the x-ray appearance of the lesion.

With the increased number of reports of pulmonary arteriovenous aneurysm in the literature, it seems certain that this lesion will lose its identity as a rare disease. It is therefore important that physicians be informed as to diagnosis and management. Although there is little doubt regarding the indications for surgery in the symptomatic patient, the indications are less well defined in the patient who lacks related symptoms. Since this lesion is now diagnosed more frequently, the continued study of its behavior, especially in the patient who is asymptomatic, will clarify the long-term prognosis and crystallize the indications for surgery.

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Patients who frequently or habitually use oily nasal medications or swallow mineral oil at night for constipation may unknowingly aspirate the oil in sufficient quantity to produce a lipoid granuloma of the lung that is indistinguishable from bronchogenic carcinoma. Thus several undiagnosed cases have had much more radical surgery than necessary, since a simple localized resection suffices for lipoid granuloma whereas cancer of the lung calls for pneumonectomy. An accurate history may prevent the employment of some of these unnecessarily radical procedures. (*Richard A. Leonardo, M.D.*)

Natural History of Osteoid Osteoma of the Spine

REVIEW OF THE LITERATURE AND REPORT OF THREE CASES

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IN 1930 Bergstrand reported two cases of osteoid osteoma and gave the classic clinical, roentgenologic and histopathologic description of this disease. Jaffe[4] in 1935 reported five cases of this lesion, discussed its possible origin and proposed the name "osteoid osteoma," thus establishing it as a separate entity with characteristic clinical, pathologic and roentgenologic findings. He also reported the first case of osteoid osteoma of the spinal column.

Survey of the literature disclosed reports of more than 200 cases of osteoid osteoma. It has been noted in almost every bone of the skeleton, even in presumably rare locations such as the skull, mandible, ribs, scapula and sacrum. A variant of osteoid osteoma, a benign osteoblastic lesion of large size (5 to 12 cm.) mentioned by Jaffe,[4] has been described in the spine by Marzagalli and by Dahlin and Johnson, who proposed the name "giant osteoid osteoma."

We found in the literature reports of thirty-three cases of osteoid osteoma occurring in various parts of the spine. We wish to report three new cases of osteoid osteoma of the spine which have been seen at the Gillette State Hospital for Crippled Children, St. Paul, Minnesota.

GENERAL BACKGROUND

Six cases have been reported from Europe and one from South America; the rest have been described by American authors. Some of the reports are complete, whereas some mention only the patient's age, duration of symptoms and the location of the osteoid osteoma; six lesions are mentioned only as a mere fact and therefore the data could not be used for detailed analysis.

The lesion is usually single; therefore, after excision, the microscopic diagnosis is established but the natural course of the lesion cannot be followed. However, Jaffe[5] reported a case in which a surgically treated and microscopically proved osteoid osteoma of the tibia recurred after a thirteen-year interval of freedom from symptoms. Lewis described an osteoid osteoma in the thoracic portion of the spine that was operated upon and proved microscopically. After eleven months it recurred in the same place. Osteoid osteoma never has been observed to metastasize. The lesion has not been produced experimentally.

Bergstrand expressed the opinion that osteoid osteoma, if left alone, could heal spontaneously. Moberg described spontaneous healing of osteoid osteoma in a metacarpal bone without any treatment in an eighteen year old boy over a period of two years. Sherman mentioned Phemister's patient who had osteoid osteoma in the tibia and in whom spontaneous healing took place seven years after the appearance of the first symptoms. Pritchard and McKay observed spontaneous healing of osteoid osteoma in the patella after symptoms of two years' duration. In all three of these last-mentioned cases the authors observed that the typical roentgenologic changes disappeared slowly, leaving some residual sclerosis in the formerly affected region. The diagnosis in all three of these cases was based on history, clinical observation and roentgenologic findings.

The accepted treatment of osteoid osteoma in the spine, as elsewhere in the body, is excision or thorough curettement of the nidus when possible. Roentgen therapy, according to many authors, is unsuccessful.

PRESENT STUDY

We have selected from our material three cases in which the histories and the clinical and roentgenologic findings strongly suggested the presence of osteoid osteoma in the spine; the subsequent course of events justifies the assumption that this benign lesion was present.

The patients were diagnosed previously as having congenital scoliosis or scoliosis of unknown origin. These three patients, one boy and two girls, have had follow-up studies; roentgenologic examination of the spine has been done at frequent intervals and for as long as eight and a half years in one patient. The condition in two patients improved without surgical treatment, and fasciotomy in the third case did not appear to contribute to cure. The lesions in all patients healed with hypertrophic residual changes in the spine; the patients became clinically asymptomatic.

CASE REPORTS

CASE 1. A nine year old white boy was admitted in January, 1952. For the past six and a half years a gradually increasing scoliosis had developed in the lower thoracic and upper lumbar portions of the spine, with acute pain in the back and a "peculiar and awkward gait," the patient walking on the toes of the right foot. No treatment was given until March, 1951, when he was advised to take active exercises for scoliosis. Shortly before admission the boy became nervous, complained of pain in the back and was restless at night due to pain. A history of previous trauma or infection was not given.

The patient stood with pronounced left scoliosis and had considerable spasm of the spinal muscles and hamstrings on the right; pronounced lordosis and tilting of the pelvis were noted, with extreme local tenderness in the upper portion of the lumbar region. Results of neurologic examination were negative. Leukocytes numbered 8,000 per cu. mm. of blood. A Mantoux test gave no reaction.

Roentgenograms, as studied in retrospect, showed a C-shaped, 25-degree, long thoracolumbar curve with its convexity to the left, extending from the tenth thoracic to the fourth lumbar vertebra, with the angular apex at the level of the first and second lumbar vertebrae. (Fig. 1.) In the right inferior portion of the lamina and pedicle of the first lumbar vertebra

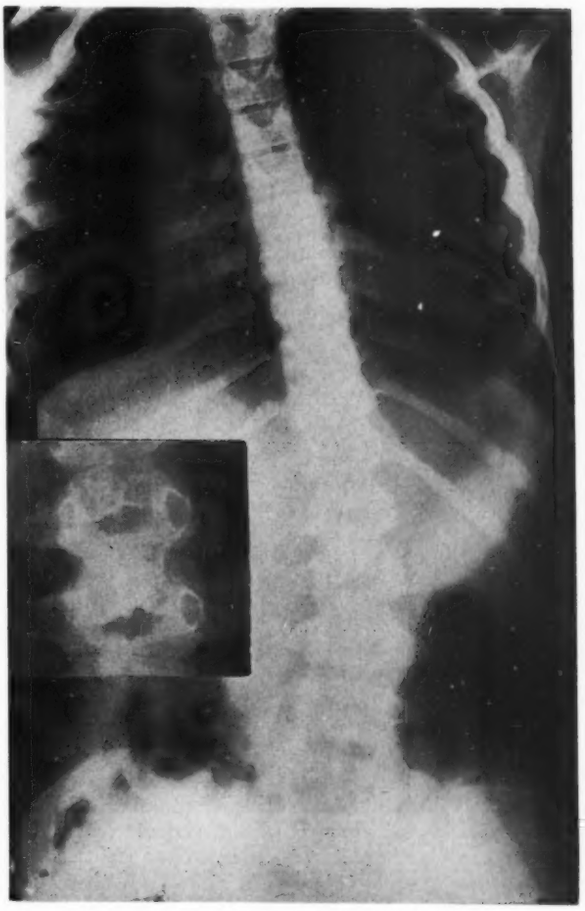

FIG. 1. Case 1. C-shaped scoliosis curve. Note perifocal sclerosis with lytic region and central sclerosis in the inferior aspect of the lamina and pedicle of the first lumbar vertebra on the right. Insert shows close-up of involved region.

there was perifocal sclerosis, with a lytic area 5 to 6 mm. in diameter in which some specks of calcification were seen.

Treatment included application of a body cast for one year and a flexion cast for two months; postural exercises were given. Roentgenologic study ten months after admission showed the scoliosis to be clearing. Later comparison showed the lytic area with central radiopaque spots, surrounded by sclerosis, still present. In November, 1953, the scoliosis was so minimal that it could not be measured. (Fig. 2.) Slight residual perifocal sclerosis was present in the right lower facet and lamina of the first lumbar vertebra. Some hypertrophic changes were noted at the articulation of the first and second lumbar vertebrae on the right side.

Examination in February, 1954, disclosed no

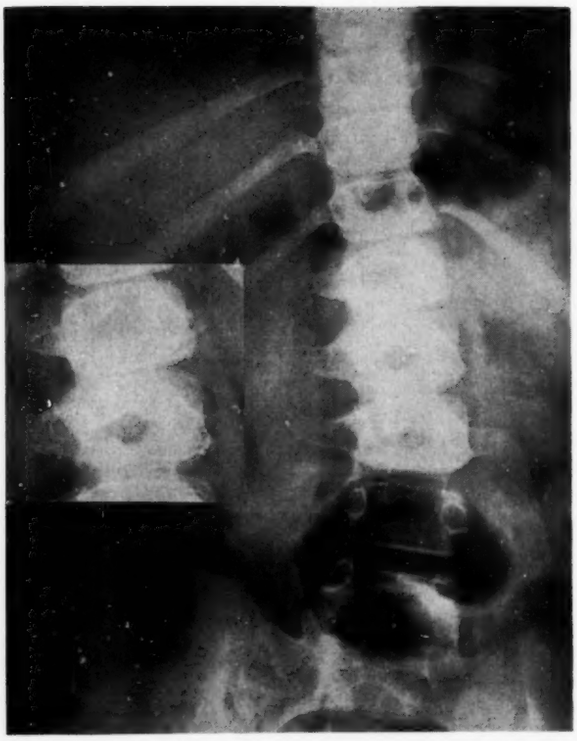

FIG. 2. Case 1. Twenty-two months later. Scoliosis is minimal. Note slight residual perifocal sclerosis in the right lower facet and lamina of the first lumbar vertebra, with hypertrophic changes in the articulation of the first and second lumbar vertebrae on the right. Insert shows close-up of involved region.

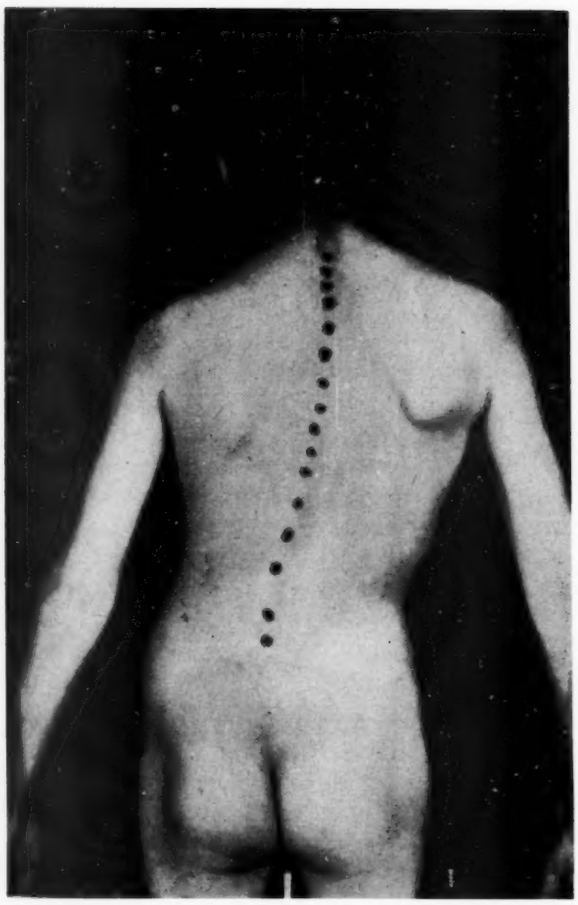

FIG. 3. Case II. Deformity of back on initial examination. Note decompensated curve of scoliosis and muscular spasm.

pain but some residual tightness in the lower part of the back. At that time the duration of the process had been eight years and eight months.

CASE II. An eleven year old white girl was admitted in February, 1947. For eleven months her mother had noticed that the girl had an awkward gait, tired easily and was restless; increasing curvature of the spine had been developing. A history of previous trauma or infection was not given.

Examination disclosed local tenderness in the lower part of the back, spasm of spinal muscles, pronounced lordosis and slight tilt of the pelvis. (Fig. 3.) Results of neurologic examination were negative. Laboratory findings were normal; the leukocyte count was 6,200.

Roentgenograms showed an angular, long, C-shaped, moderate curve in the thoracolumbar area with its convexity to the right; it extended from the twelfth thoracic to the fifth lumbar vertebra and measured 28 degrees. (Fig. 4.) Subsequent study of these films showed a sclerotic area with some hypertrophy of bone in the left lamina and superior facet of the fourth lumbar vertebra.

Treatment included postural exercises, application of a plaster body jacket for approximately eight months, and rest. Retrospective study of roentgenograms taken in November, 1950, almost four years later, showed the scoliosis to be almost absent. Asymmetric development and hypertrophy were present in the left inferior facet of the third lumbar vertebra and in the left superior facet of the fourth lumbar vertebra, associated with slight perifocal sclerosis and a central lytic area containing cloudy spots.

Roentgenologic study in June, 1952, revealed the scoliosis to be almost absent and the perifocal sclerosis practically gone. (Fig. 5.) A dense area measuring 4 to 5 mm. was densely radiopaque and stood out clearly from the

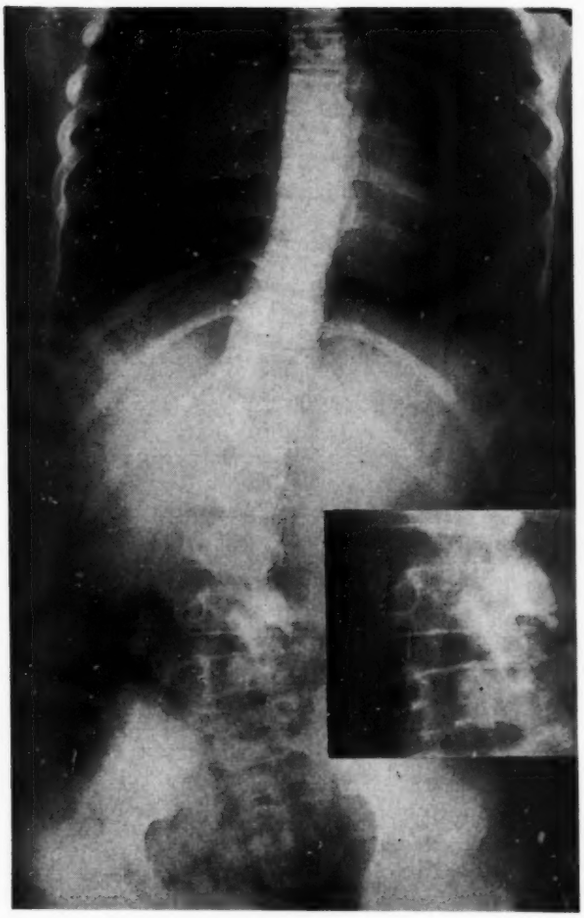

FIG. 4. Case II. Initial roentgenographic appearance. Note mild scoliosis with area of sclerosis in the pedicle of the fourth lumbar vertebra on the left, surrounding a radiolucent area with central sclerosis. Insert shows close-up of involved region.

surrounding region. Hypertrophic changes were present in the facets of the third and fourth lumbar vertebrae.

At last examination the patient was fully compensated, stood straight and had no pain; lordosis and muscular spasm were gone. (Fig. 6.)

CASE III. A ten year old white girl was admitted in May, 1945. About eight months previously the patient had started to complain about pain in the back on arising, aggravated by movement of the spine. Slight curvature of the spine had been noticed at the same time. The pain and curvature in the back had gradually increased over the past eight months. The past history was non-contributory, as were the laboratory findings; the leukocyte count was 7,500.

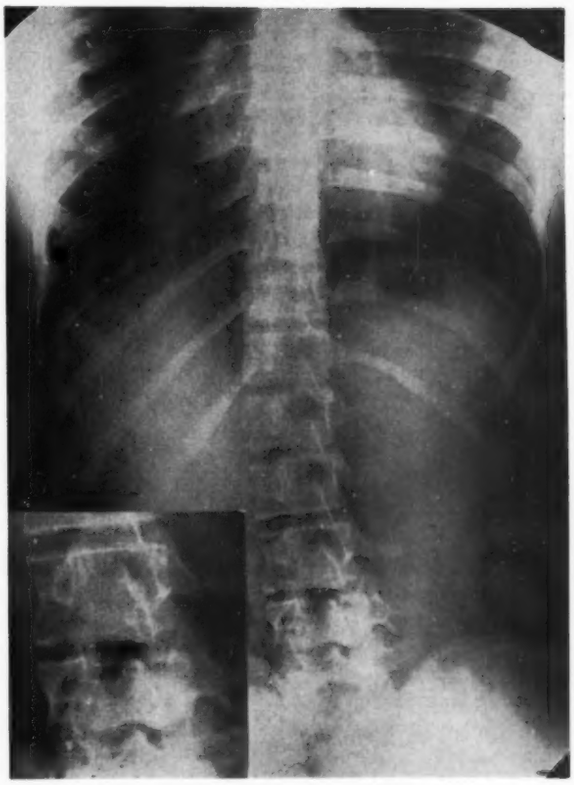

FIG. 5. Case II. Roentgenographic appearance five years after initial examination. Scoliosis is almost absent; note residual hyperplastic changes in the facets of the third and fourth lumbar vertebrae on the left. A small sclerotic area remains. Insert shows close-up of involved region.

Examination disclosed local tenderness in the lower part of the back, pronounced lordosis and spasm of the spinal muscles and great limitation of motion, especially of flexion. Results of neurologic examination were negative.

Roentgenograms taken in May, 1945, as interpreted later, showed a C-shaped curve in the thoracolumbar area, with its convexity to the right and the apex of the curve at the first lumbar vertebra. (Fig. 7.) An area suggestive of hyperplastic bone was present in the left superior pedicle of the first lumbar vertebra. In the facet and adjacent pedicle was an osteolytic area approximately 5 mm. in diameter which was surrounded by an almost non-sclerotic perifocal zone.

In August, 1945, bilateral transverse fasciotomy of the lumbosacral fascia was performed. The patient wore a canvas corset and later a back brace. Roentgenologic checkups were made at six-month intervals. The curve of scoliosis slowly increased until January,

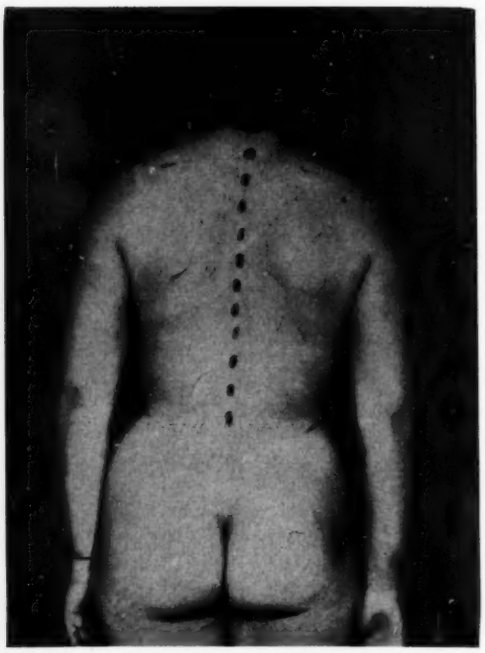

FIG. 6. Case 11. Appearance of back six years after initial examination.

1948, at which time it measured 48 degrees. It then remained stationary until December, 1953. The back gradually got stiffer, with pain increasing over the upper part of the lumbar portion of the spine.

In April, 1948, roentgenologic examination disclosed pronounced rotation of the upper part of the lumbar portion of the spine. (Fig. 8.) Early hypertrophic changes were noted in the apophyses on the left side of the first lumbar vertebra. A central radiopaque area was noted in a less dense perifocal background. In June, 1950, the radiopaque central area was surrounded by reactive sclerotic bone with hypertrophic changes. Examination in December, 1953, disclosed residual structural scoliosis with restitution of normal bony texture in the area of the former nidus, with persistent hypertrophic changes. (Fig. 9.)

In our three cases of osteoid osteoma of the spine the duration of the process was approximately eight, six and four years, respectively. In the first two cases the scoliosis, spasm and lordosis disappeared with cessation of symptoms without any residuals except for some hypertrophic changes localized to the region of the pathologic process. In the third case residual scoliosis of moderate degree remained after cessation of symptoms, along with lumbar lordosis of severe degree. A two-year follow-up in this last case showed the same stationary scoliosis. It is difficult to say why structural scoliosis developed in the third case; possibly it was due to the location of the osteoid osteoma with relation to centers of growth or to persistent contracture of soft tissues.

The roentgenologic findings in all three cases showed residual hypertrophy of adjacent facets and residual increased density of bone, with obliteration of the nidus in a different length of time in each.

SUMMARY OF CLINICAL DATA (THIRTY CASES)

As already indicated, thirty-six cases of osteoid osteoma of the spine have been reported, including our three cases. In this study we analyzed the records in thirty cases, the aforementioned six cases being excluded for lack of pertinent data. Eighteen patients were males and ten were females; the sex was not given in two cases. The ratio of males to females of 2:1 found in osteoid osteoma in all locations also was represented in lesions of the spine. The ages of the patients when clinical symptoms first appeared are shown in Table 1. The age between ten and twenty years is the most common for osteoid osteoma of the spine. The youngest patient was three years of age, whereas the oldest was twenty-seven. With regard to osteoid osteoma elsewhere in the body, the youngest patient when symptoms appeared was ten months of age and the oldest was fifty-five.

The duration of symptoms before these patients were seen by the physicians who reported the cases varied from three months to thirteen years, the average being twenty-four months. Patients who had symptoms lasting longer than two years usually had been treated elsewhere before.

Location. The location of these thirty osteoid osteomas of the spine is seen in Figure 10. Five osteomas were in spinous processes; of the remaining twenty-five, thirteen were on the left side and twelve on the right. It appears that the lamina, with or without involvement of the adjacent pedicle, is the most common site of osteoid osteoma in the vertebra. The body of the vertebra was involved from the adjacent parts in four instances.[2,7,14] The body of the vertebra as a primary site of an osteoid osteoma was noted in one instance.[2] It is remarkable that all these lesions involving the

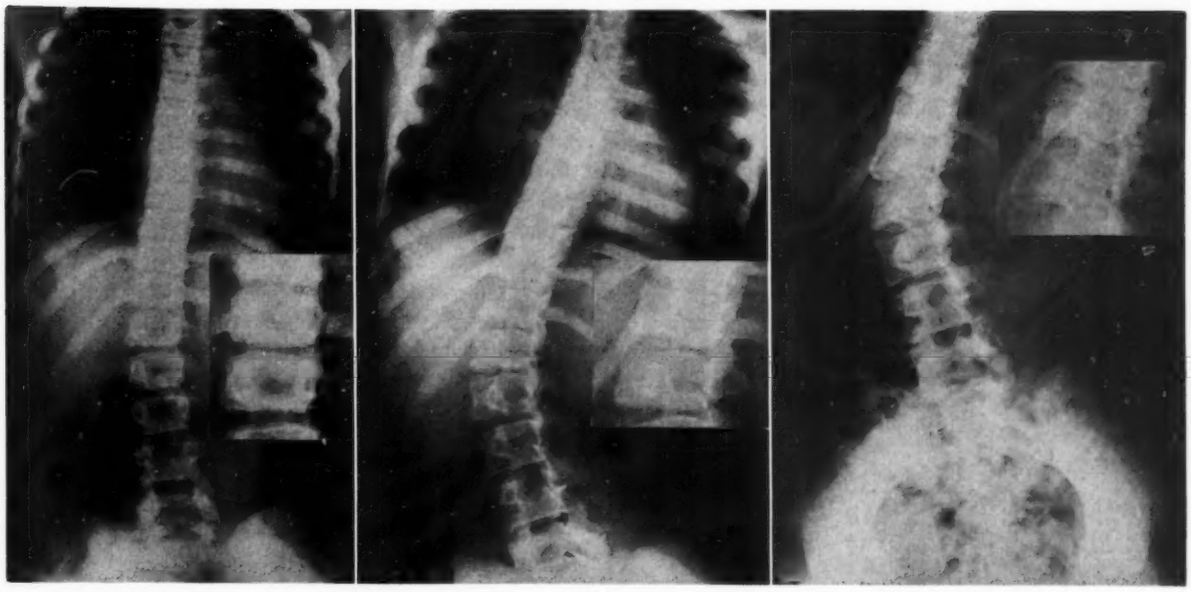

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FIG. 7. Case III. Initial roentgenographic appearance. Note moderate scoliosis and early hyperplastic changes in the facets between the twelfth thoracic and the first lumbar vertebrae on the left. Insert shows close-up of involved region.

FIG. 8. Same case. Roentgenographic appearance three years later. The scoliosis has increased and there is some maturation of the osteoid osteoma. Insert shows close-up of involved region.

FIG. 9. Same case. Roentgenographic appearance eight and a half years after initial examination. Residual structural scoliosis is present, with restitution of normal bony texture in the region of the former nidus and persistent hypertrophic changes. Insert shows close-up of involved region.

vertebral body, except for that in Walker's case, were so-called giant osteoid osteomas.

Trauma. Possible trauma was mentioned in two cases, in which it occurred two and three months, respectively, previous to onset of the first symptoms. Previous trauma was absent in twenty-five cases, and possible trauma was not mentioned in three. Reports on osteoid osteoma involving bones elsewhere than in the spine mentioned possible trauma in approximately 30 to 40 per cent of cases.[3,4] Thus it appears that trauma as an initiating factor in osteoid osteoma of the spine is rather a remote possibility.

Symptoms. Pain is the most common symptom. It is usually described as a localized ache that increases gradually with time. The first symptom in one case was torticollis,[13] whereas stiffness of the lower part of the thoracic portion of the spine with "crooked" gait appeared initially in another;[9] pain appeared approximately six months later in both these instances.

Pain at night was reported in eight cases, and referred pain was mentioned in five. Referred pain with clinical symptoms suggestive of a protruding intervertebral disk was reported in one case.[3] Localized tenderness on pressure was present in practically every case early in the process.

Scoliosis of the involved segment of the spine, usually of moderate degree and with a long C-shaped curve with the apex at the level of the lesion, was described in eighteen cases. Scoliosis was absent in six cases; in five of these the lesion was in the spinous processes and in one it was in the sacrum. Data regarding

TABLE I
AGES OF PATIENTS AT APPEARANCE OF SYMPTOMS OF OSTEOID OSTEOMA OF THE SPINE

Age (yr.)	No. of Patients
0–5	2
6–10	5
11–15	9
16–20	7
21–25	4
26–30	1
Unknown	2

scoliosis were insufficient in the remaining six cases. Thus scoliosis with a typical C-shaped curve is one of the most common findings in osteoid osteoma of the spine. Scoliosis of the spine with unilateral muscular spasm and limitation of motion developed in the only two

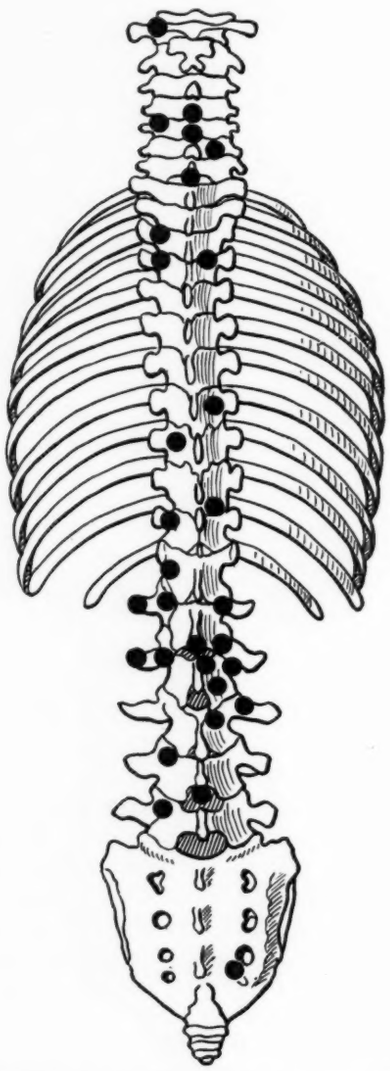

FIG. 10. Location in the spine of the 30 osteoid osteomas considered in this study.

reported cases of osteoid osteoma in the ribs.[5,10] In both cases relief from pain, spasm and scoliosis was obtained by surgical treatment. An osteoid osteoma of the ilium reported by Lewis produced scoliosis, limp, spasm of the spinal musculature and a tilt of the pelvis.

Spasm of the musculature, with more or less severe limitation of motion of the spine, was the next most common finding. It was usually more pronounced when the osteoid osteoma was located in the cervical or lumbar portion of the spine.

Lordosis due to spasm of the spinal musculature was present in many cases in which the osteoid osteoma was located in the lumbar portion of the spine. In four of five cases of osteoid osteoma located in the dorsal spinous processes, lordosis or rigidity of the neck was reported. Mild kyphosis, together with scoliosis, was reported in three instances in which the lesions were located in the fourth and ninth thoracic and the second lumbar vertebrae.

More or less severe symptoms of compression of the cord were reported in four cases. Spastic paraplegia was present in two of these cases; it was relieved completely by operation in one, whereas partial relief was obtained in the other.

Swelling over the region of the lesion, which is so common a finding in osteoid osteoma elsewhere in the skeleton, was reported in three cases, in which lesions were present in the spinous process of the fourth cervical, the lamina of the twelfth thoracic and the transverse process of the second lumbar vertebrae. The swelling in all three cases appeared as a late clinical finding.

Weakness in the extremities without neurologic changes was reported in two cases. Limp was observed twice, but "awkward" or "crooked" gait was mentioned frequently.

Laboratory Tests. Laboratory findings as a rule were reported as normal or were not mentioned. Results of study of cerebrospinal fluid were reported as normal in eight cases; evidence of block was present in two cases and the protein was increased in one case. Cerebrospinal fluid was not mentioned in the rest of the cases.

Roentgenologic Findings. The available data in the initial roentgenologic studies are summarized in Table II. The obvious lack of sclerosis or the minimal sclerosis even in osteoid osteomas of long duration is due to the fact that the vertebra, as a spongy cancellous bone, lacks the compactness that usually accounts for increased perifocal sclerosis.

The duration of symptoms in the three cases in which results of initial roentgenologic study were normal was four months, one year and two years, respectively.

The duration of the process ranged from two to six and a half years in the six cases in which

hypertrophic changes were found adjacent to the lesion.

Correlation of these roentgenologic findings with the duration of symptoms and the patients' ages appeared to indicate that:

1. Roentgenologic findings could be normal even after prolonged pain, scoliosis and muscular spasm.

2. Perifocal sclerosis is usually not prominent.

3. The age of the patient and the location of the lesion in the spine appear to have no influence on the relationship between the duration of the lesion and its roentgenologic picture.

4. Radiolucent immature lesions were described about as frequently as were mature radiopaque niduses, with similar variation in length of duration of symptoms. We could only assume that every osteoid osteoma may have its individual cycle of activity and that one year after the onset of symptoms the roentgenogram could be normal or could show a small immature nidus or even a mature lesion with a radiopaque nidus and more or less perifocal sclerosis.

5. Hypertrophic changes noted roentgenologically have a direct relationship to the duration of the lesion but no relationship to the location of the lesion or the age of the patient. Therefore it would appear more plausible that hypertrophic changes adjacent to the lesion are due rather to chronic increased local osteoblastic activity than to stimulation of the growth of the apophyseal centers of the vertebra during periods of increased growth of the spine.

In our three cases hypertrophic changes adjacent to the lesion were observed after symptoms had been present for eight, three and three years, respectively. Residual increased density of bone in the region of the lesion was observed in all three cases more than two years after cessation of clinical symptoms.

TABLE II

FINDINGS ON INITIAL ROENTGENOLOGIC STUDY IN THIRTY-SIX CASES OF OSTEOID OSTEOMA OF THE SPINE

Findings	No. of Cases
No detailed description	5
Initial roentgenogram normal	3
Radiolucent area of destruction	4
Radiolucent area with surrounding minimal increased sclerosis	6
Destruction with radiopaque areas	3
Radiolucent area with adjacent sclerosis	3
Radiopaque nidus surrounded by radiolucent ring and by sclerosis to periphery of ring	2
Radiopaque nidus in radiolucent area with no or minimal sclerosis to periphery	4
Hypertrophic changes in area adjacent to lesion	6

TABLE III

PREOPERATIVE DIAGNOSES IN TWENTY-SEVEN CASES OF OSTEOID OSTEOMA OF THE SPINE

Diagnosis	Cases
Several diagnoses or undecided	14
Osteogenic sarcoma	4
Osteomyelitis	2
Giant cell tumor	2
Spondylitis	2
Scoliosis	2
Osteoid osteoma	1

Preoperative Diagnosis. The initial preoperative diagnoses in the twenty-seven of these thirty cases in which operations were performed are listed in Table III. Operation was not performed in three cases.

Treatment. No reports were found of an attempt to treat osteoid osteoma of the spine by roentgen therapy before operation or as an additional measure for conservative treatment. Roentgen therapy was given postoperatively in four cases in which the initial microscopic diagnoses were giant cell tumor (two cases), osteogenic sarcoma (one case) and malignancy (one case). Roentgen treatment was discontinued in all of them when the microscopic diagnosis of osteoid osteoma was made.

Preoperative treatment, consisting mostly of use of plaster of paris jackets, leather collars, corsets, traction and postural exercises, was mentioned in ten cases. Conservative treatment was continued on an average of from eight to eighteen months but was without much value in almost all instances except in our three cases. Diagnostic biopsy, followed later with surgical intervention, was reported in three cases.

The various operations performed for surgical management included block excision, curettement, laminectomy, excision of spinous or transverse processes and foraminotomy. A

microscopic diagnosis was made in all twenty-seven cases in which operations were performed.

Recovery after operation with complete relief of pain, scoliosis, lordosis and spasm of spinal musculature was reported in all instances.

In cases in which symptoms of compression of the cord were present, the relief was incomplete in one and complete in the rest.

Recovery without operation in two of our cases was accompanied with complete relief of pain, scoliosis, lordosis and muscular spasm; in our third case, in which fasciotomy was performed, there was relief of pain but lordosis and some scoliosis persisted.

COMMENT AND CONCLUSIONS

Data concerning the thirty-three cases of osteoid osteoma reported in the literature, together with our study of three additional cases, give rise to the following observations:

The location of osteoid osteoma in the spine is more common in the cervical and lumbar segments, where the mobility of the spine in all planes is maximal, than it is in the thoracic portion. Localized pain at the site of the lesion is the most common first clinical sign. A typical C-shaped long scoliosis curve of mild or moderate degree, with the apex at the level of the lesion, is practically always present.

Torticollis produced by lesions in the cervical part of the spine corresponds to the scoliosis produced by lesions in the lower segments of the spine. Pronounced asymmetric lordosis and stiffness of the spine are common findings. Lesions in the spinous processes do not produce torticollis or scoliosis but do produce stiffness in the spine with inability to flex the neck or the lower portion of the spine, according to the site of the lesion.

Hypertrophic changes appear if the duration of the lesion exceeds two years. Osteoid osteoma of the ribs or ilium produces a clinical picture similar to that of osteoid osteoma in the lumbar portion of the spine.

The roentgenologic picture in osteoid osteoma is a most valuable single diagnostic aid. After a detailed analysis of the initial roentgenologic findings in osteoid osteoma of the spine, it is obvious that the roentgenologic diagnosis of osteoid osteoma is more difficult when this lesion is in the spine than when it is in other bones for several reasons, as follows: (1) Due to the rarity of this lesion in the spine, the physician does not suspect the possibility of it until histologic examination is done. (2) Roentgenograms often are inadequate due to technical difficulties and the complicated anatomic structure of the vertebrae. (3) Roentgenograms can be normal even after prolonged duration of clinical signs and symptoms. (4) Perifocal sclerosis, even in old lesions, is minimal because the vertebra is cancellous in nature.

The diagnosis of idiopathic or congenital scoliosis should be carefully scrutinized in every case of scoliosis with a long C-shaped curve accompanied with spasm of spinal musculature, localized tenderness and lordosis. Roentgenography should be repeated every three or four months. Use of localized views, different planes and tomography could be helpful.

In differential diagnosis, besides infection, benign and malignant lesions and protruded disk, the physician should keep in mind exclusion of residual scoliosis after acute poliomyelitis, as well as congenital or idiopathic scoliosis. Less common lesions to be considered are aneurysmal cysts of bone, eosinophilic granulomas and osteoid osteomas of the ribs or pelvis.

Surgical treatment of osteoid osteoma in the spine is more difficult than is that of osteoid osteoma in other bones, but it apparently is always successful in relieving the clinical symptoms.

Roentgen therapy with or without established microscopic diagnosis is not advisable, since osteoid osteoma is considered a benign lesion and the dangers of radiation are greater than those of surgical intervention.

Our three cases serve as examples of osteoid osteoma in the spine with different durations of their natural course. Residual anatomic and roentgenologic changes, with residual increased density of the bone in the region of the obliterated nidus, were present in our cases.

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Postphlebitic Syndrome

MAJOR VEIN LIGATION AND/OR LUMBAR SYMPATHECTOMY

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THE postphlebitic syndrome, or chronic deep thrombophlebitis, still remains a complexing and disabling problem. The physiopathologic changes occurring in the involved venous channels of the pelvis and lower extremities are better understood today as a result of a combination of clinical evaluations and laboratory studies. The process of recurring thrombosis and recanalization of these involved channels contributes to and is responsible for many of the patient's symptoms and physical findings.

The disease process usually results in considerable disablement. The local changes induce edema, coldness, clamminess, cyanosis, pain, cellulitis, varicose veins with or without ulcers, stasis dermatitis, fungous infections, and perivenous or subcutaneous fibrosis. Any or a combination of these may restrict the patient's activities. The partially recanalized vessel, the associated valvular incompetency and the resultant vasospasm are important factors responsible for the changes listed heretofore. In addition, a certain number of these patients will have recurrent pulmonary emboli or infarctions and/or a propagating thrombosis. Either of these processes may terminate fatally. The first embolic manifestation may prove fatal in 24 per cent of the cases; however, of surviving patients, 23 per cent may have recurrent episodes, resulting in fatality in 60 per cent. The continual propagation of the thrombotic process may eventually ascend in the inferior vena cava finally to occlude the renal veins, resulting in renal failure and death.

Because of these factors we have favored ligation of the major vein involved, preferably the inferior vena cava, and the simultaneous performance of lumbar sympathectomy. Our rationale for this approach to the problem is manifold, namely: to prevent further pulmonary infarctions and blockage of the renal veins; to eliminate the recurrent thrombophlebitic process; to relieve vasospasm and to allow for the development of vascular collateral channels, thereby improving peripheral circulation to the extremities; eliminate sweating which will increase warmth of the extremity and will prevent skin maceration and cracking between digits and thereby reduce or eliminate cellulitis, lymphangitis and fungous infections; finally, to eliminate or reduce the severity of pain because of division of the vasosensory (sympathetic) supply to the vascular tree of the extremity.

Clinical Study. This report concerns thirty-eight adult men upon whom major vein ligation and/or lumbar sympathectomy was performed for treatment of the postphlebitic syndrome. In eighteen (47.6 per cent) patients, average age 50.2 years (youngest twenty-two and oldest seventy-two), a major vein was ligated and lumbar sympathectomy was performed. (Table 1.) In twenty (52.4 per cent) patients, average age 44.2 years (youngest twenty-two and oldest sixty-five), only lumbar sympathectomy was performed.

The causes of this syndrome in this group of patients were quite varied. In seven (18.4 per cent) cases the condition followed surgery; in the remaining groups it was due to recurrent acute thrombophlebitis and secondary to immobilization due to medical diseases or conditions.

The average duration of symptoms prior to this method of treatment was 8.2 years in the major vein ligation group as compared to 6.3 years in the lumbar sympathectomy series. In those patients who underwent vena cava ligation the average duration of symptoms was 13.5 years, which is the longest period in any group studied. The shortest period was two months and the longest thirty-six years.

Two-thirds of the patients in both groups prior to this method of therapy had been treated with conservative methods; 42 per cent underwent saphenous vein ligation; several had

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skin-grafting procedures; and a small number were treated with anticoagulant therapy, local sympathetic blocks, or received no treatment at all. Four patients had had previous ligation of the superficial femoral vein.

TABLE I
SITE OF MAJOR VEIN LIGATION

Vein Ligated	Number
Inferior vena cava	9*
Common iliac	6*
External iliac	1
Superficial femoral	3

* One patient had common iliac vein ligated, followed in one month with inferior vena caval ligation.

Pulmonary Infarction. In fourteen (36.8 per cent) patients pulmonary infarction occurred prior to this method of therapy. In only three (20 per cent) of the patients in the group treated with sympathectomy alone did infarction occur prior to this procedure. However, in one of these patients an infarct developed following sympathectomy. In the group of patients in whom a major vein was ligated fourteen (36.8 per cent) had a history of previous pulmonary infarction. In fact the average number of infarctions was two, and in several it had occurred three times. The relation of the time of infarction to the onset of the disease was noteworthy. In many instances the first infarction occurred within the first two weeks or two months from the onset of the disease; however, in many cases recurrent infarctions occurred one to thirty-five years later. These are important considerations in the selection of patients with this syndrome for either a major vein ligation and sympathectomy or a sympathectomy alone.

It is important to note, also, that no infarctions occurred following vena caval ligation when the source was from the extremities or pelvic veins. In one case in which a unilateral common iliac vein ligation was performed pulmonary infarction occurred which necessitated ligation of the inferior vena cava.

Preoperative Symptoms and Findings. Pain, edema and recurrent phlebitis were the most common complaints and findings in both groups studied, occurring in over 50 per cent of the cases. Cellulitis, ulceration and stasis dermatitis were present in at least one-third of the cases. Coldness, excessive sweating and easy fatigability of the extremity are present less frequently than the others listed heretofore.

Level of Thrombosis. In the eighteen patients upon whom a major vein ligation was performed the upper level of thrombosis was determined at the time of surgery in eighteen. (Table II.) In several cases it was determined preoperatively by venograms.

TABLE II
UPPER LEVEL OF THROMBOSIS

Site		Number
Vena cava		2
Above renal veins	1	
Below renal veins	1	
Common iliac		7
External iliac		3
Common femoral		2
Superficial femoral		1
Undetermined		3

RESULTS

The average follow-up was thirty-six months in the major vein ligation group as compared to thirty-four months in the lumbar sympathectomy group. There were no operative or postoperative deaths.

The over-all evaluation of results in either group is a difficult problem, for in both there are a number of changes and complaints which cannot be reversed by any method of therapy. This is due to primary and secondary changes in the vascular channels, as well as the surrounding tissues of the extremities.

However, certain benefits are apparent in both series. In such an assessment of results it is necessary to bear in mind that the more complicated case was relegated to the group of the combined surgical procedure, whereas in those individuals treated with lumbar sympathectomy alone the disease process was limited and showed less preoperative disablement.

Sympathectomy in both groups resulted in a warm and dry extremity, thereby improving the general circulation of the extremity and also eliminating recurrent fungous infections. A significant reduction in cellulitis was noted.

The ligation of a major vein did not result in further disablement in most of the cases. Recurrent phlebitis did not occur in those who

FIG. 1A. Anterior view of the extremities of a fifty-two year old man thirty-five weeks after inferior vena caval ligation and right lumbar sympathectomy for bilateral deep chronic thrombophlebitis with repeated pulmonary infarctions.

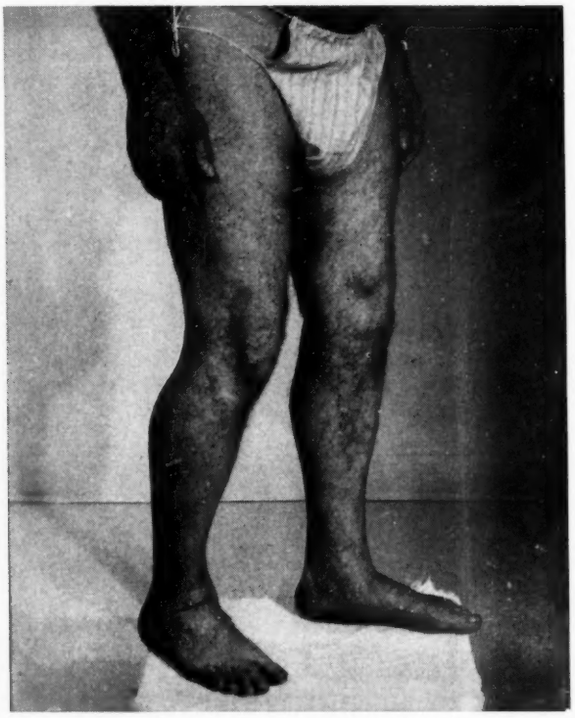

FIG. 1B. Lateral view of extremities of the same patient as shown in Figure 1A, also taken thirty-five weeks postoperatively, showing both limbs equal in circumference with no edema. Fifty-two months later limbs were equal in diameter with no edema, ulcerations, stasis dermatitis, varices or recurrent phlebitis.

had either a vena caval or common iliac vein ligation. In 30 to 50 per cent of the cases the patient was able to return to work. Elastic stockings were needed in almost all cases in which the ligation of a major vein was above the superficial femoral vein. The edema which accompanied the disease improved with time in most individuals in both groups. In about 50 per cent of the cases the edema noted was not severe and was usually present by the end of the day if the patient had been active.

In over 40 per cent of the cases walking distance improved. Burning, aching and tenderness of the limbs were notably improved in both series. This complaint appeared less frequently in the group who underwent vena caval ligation and sympathectomy.

Recurrent ulceration of the limb occurred more frequently in the group who underwent only sympathectomy.

Varices developed in 25 to 50 per cent of the patients with major vein ligations, as compared to 13 per cent in the sympathectomy group. Recurrent phlebitis did not occur in those patients who underwent high major vein ligation, whereas phlebitis developed in 50 per cent of the patients with superficial femoral vein ligation and the group who underwent only lumbar sympathectomy.

The circumference of the limbs was decreased in 25 per cent of the patients with vena caval ligations, in 50 per cent of the patients with superficial femoral vein ligation and in 40 per cent of the patients with only lumbar sympathectomy. (Fig. 1A and B.)

COMMENT

Major vein ligation, when indicated as outlined in the beginning of this article, should be accompanied with adequate lumbar sympathectomy. In those cases of postphlebitic syndrome or chronic thrombophlebitis the combined procedure results in many beneficial effects which outweigh any of the undesirable sequelae which occasionally develop. It is our opinion that disablement does not occur as a result of these procedures; in fact, improvement in many complaints and in local physical

changes is so favorable as to improve the over-all activity of the individual.

Ligation at the proper level will prevent further pulmonary infarction and will arrest the process of recurrent phlebitis and propagating thrombosis. It is our opinion, too, that when thrombosis has occurred above the confluence of the femoral veins, superficial and deep, it is safer and more physiologic to ligate the inferior vena cava rather than the external or common iliac veins.

The division of the sympathetic supply to these extremities results in improvement of circulation, both arterial and venous. It eliminates sweating, which with the aforementioned change results in a warmer and drier extremity. This, alone, is an important consideration since it contributes immeasurably to reducing the incidence of cellulitis and recurrent infections, particularly those of fungous origin. By division of these nerve fibers, the vasosensory pathways are interrupted, thereby eliminating or reducing the severity of peripheral pain.

The vascular system has great reserve potentialities via the development of large collateral channels which provide for the return of blood from the extremities to a point above the venous obstruction, such as the iliacs or inferior vena cava. These were seen at the time of ligation in many of the patients who had obstruction of a major vein.

SUMMARY AND CONCLUSIONS

A review of the results of major vein ligations and lumbar sympathectomy or sympathectomy alone in the management of chronic thrombophlebitis (postphlebitic syndrome) is presented. The indication for this procedure was limited to those individuals with recurrent pulmonary infarctions and/or recurrent propagating thrombosis associated with increasing disablement.

The over-all results in the group with vena caval ligation and lumbar sympathectomy were better than those with other types of major vein ligation. This procedure prevented further recurrent phlebitis and ascending thrombosis, and eliminated infarctions. In a fairly high percentage of the cases improvement in circulation occurred, with a resultant warmer and drier extremity, as well as lowered incidence of cellulitis and associated local infections, and in 25 per cent a reduction of edema of the extremity.

The degree of disability in many was lessened, and in no cases could it be directly responsible for invalidism.

The combined procedure of vena caval ligation and sympathectomy appears to be the operation of choice in the group of patients with the conditions outlined in the indications previously described.

The Treatment of Slipping Femoral Epiphysis (Epiphysiolysis)

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THROUGH an unusual and entirely fortuitous circumstance, two boys thirteen years of age, each suffering from slipping femoral epiphysis, were observed in the same hospital ward at the same time. The degree of epiphysial displacement was minimal in each case, and in fact it can be said that the two cases were quite similar in every detail but for one significant exception. They had different doctors, and one of the children was operated upon, a triflanged nail being inserted, whereas the other was treated in short leg casts fastened together with sticks so as to prevent weight bearing and gravitational stresses of external rotation. We mention these two cases only to illustrate the variation in methods of treatment now in vogue for slipping femoral epiphysis. Some surgeons advocate nailing *in situ* as soon as the diagnosis is made, under the impression that this is the only sure method of preventing serious further displacement.* Others recommend and practice surgical obliteration of the epiphysial plate by inserting a bone graft or peg from metaphysis to epiphysis across the cartilaginous epiphysial plate.

If a slip of consequence has already occurred, some surgeons boldly open the hip joint, perform a wedge osteotomy through the anteriorly angulated area, replace the head and fasten it tightly to the neck with nail, pins or screws. We use the term "boldly" because here we have an instance of deliberate and premeditated production of one of our most troublesome problems, intracapsular fracture of the hip. (Fig. 1.)

Twenty years ago one of us (D. K.) received an emergency call from the operating room to assist a surgeon who was in trouble with a case of slipping femoral epiphysis. He had intended to insert a nail, but on internally rotating the limb, he had produced a spiral subtrochanteric fracture. Not knowing what else to do, we applied a hip spica cast, taking advantage of the fracture to correct the external rotation deformity which was present. After approximately four months' time the fracture healed and the epiphysial plate was practically ossified. An excellent range of motion was obtained. The patient served in the armed forces during World War II; and when he was followed up in 1954, his hip was for all practical purposes quite normal. Noting this favorable outcome after immobilization in a hip spica cast, we began using this method as a routine treatment for slipping femoral epiphysis. However, the method was abandoned because occasionally a patient with slipping epiphysis will have, or develop, arthrofibrosis* in the same hip. We have seen four such cases, and in all fibrous ankylosis developed while the patient was under treatment. For example, patient E. P. was immobilized for three months in a hip spica cast in 45 degrees' abduction. After the cast was removed, the hip remained stiff in the abducted position despite prolonged and vigorous physical therapy, traction and manipulation under anesthesia. X-rays (Fig. 2) revealed a thin joint space, and at operation for arthrodesis there were islands of fibrous adhesions across the joint replacing the articular cartilages in irregular areas. Undoubtedly, this fibrosis had been encouraged by the hip spica immobilization but it has also been observed in at least two patients who were treated with the insertion of triflanged nails without their hips ever having been immobilized. For example, patient K. S., a fifteen year old girl, had had a nail inserted some six months before coming to our clinic. The operation had been performed without opening the joint and there was not the slightest evidence

* No effort is made to reduce the displacement.

* "Arthrofibrosis," a term coined by Vernon Luck to describe the pathologic condition found in certain joints which stiffen following trauma and immobilization.

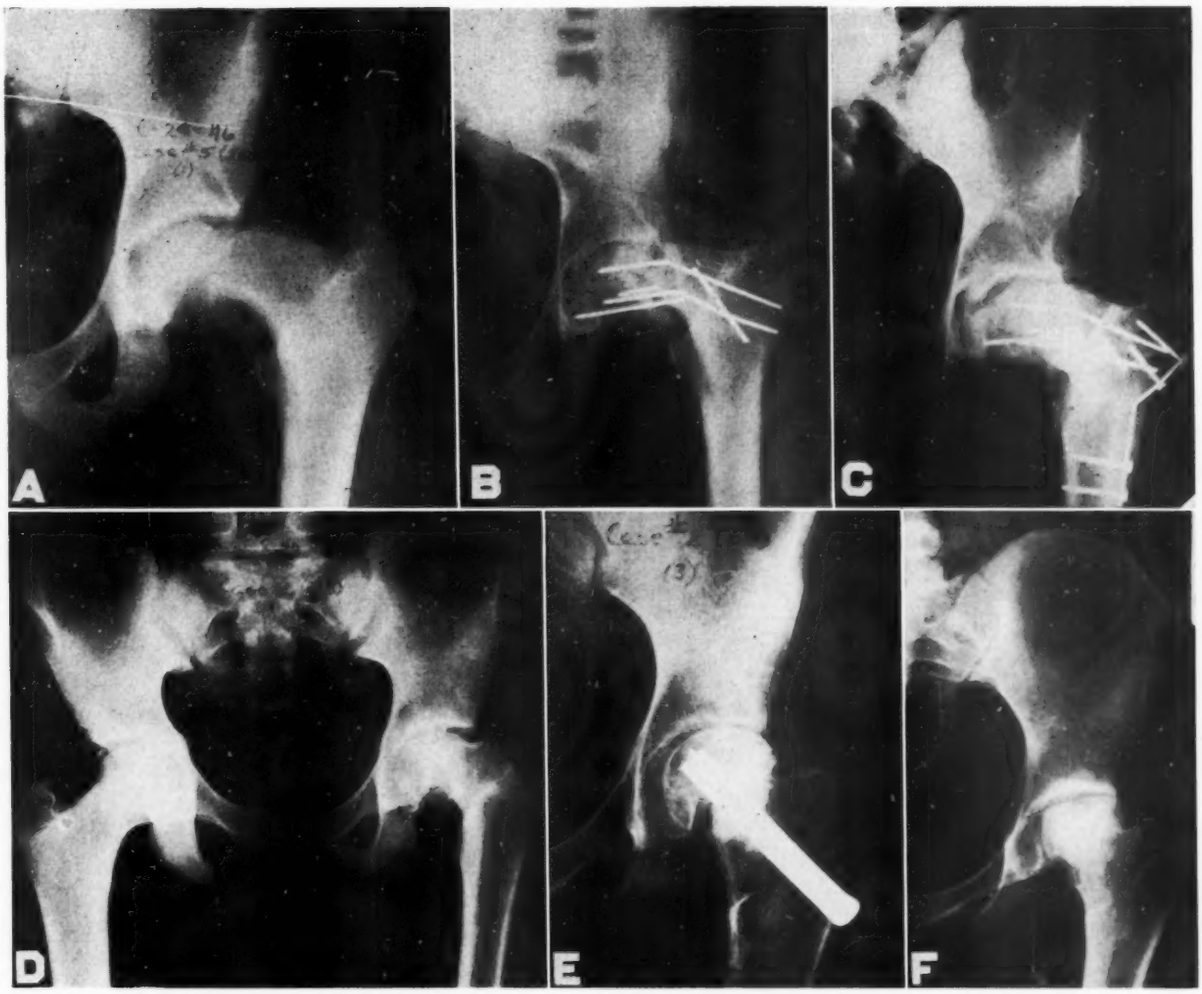

FIG. 1. A, slipped femoral epiphysis in a fourteen year old boy. B, one year after osteotomy. Patient has non-union; broken wires. Medial fragment of lower wire has penetrated head. C, nine years after subtrochanteric osteotomy. Patient has union but also has aseptic necrosis and painful traumatic arthritis. Wires could not be removed. Result poor. D, slipped epiphysis in a thirteen year old girl. E, one year after osteotomy and insertion of triflanged nail. F, eight years later. Aseptic necrosis; painful traumatic arthritis. Result poor.

of any postoperative inflammatory reaction. Nevertheless, despite exercises, administration of cortisone and manipulations, the hip became stiff and painful; at operation for arthrodesis a fibrous ankylosis was encountered. (Fig. 3.)

Pretreatment sedimentation rates were normal in these four cases, but careful review of the pretreatment x-ray films shows evidence of thin joint space and irregular articular surfaces in two cases.

Needless to say, we have not used hip spica casts in the treatment of slipping femoral epiphysis since we recognized this possible complication. However, it is our belief that ankylosis is probably inevitable in these cases no matter what form of treatment is used.

METHOD NOW EMPLOYED

For the past ten years we have treated these patients in a very simple way. We apply short leg casts, abduct the legs a trifle and fasten the casts together with the affected leg in as much internal rotation as the hip will permit.* (Fig. 4.) The casts serve the dual purpose of preventing weight bearing and eliminating external rotatory stresses on the epiphysial plate. Within a few days' time pain and muscle spasm disappear so that exercise can be encouraged. Sitting up, traveling about on a scooter and, when supine, lifting the cast-

* Without anesthesia.

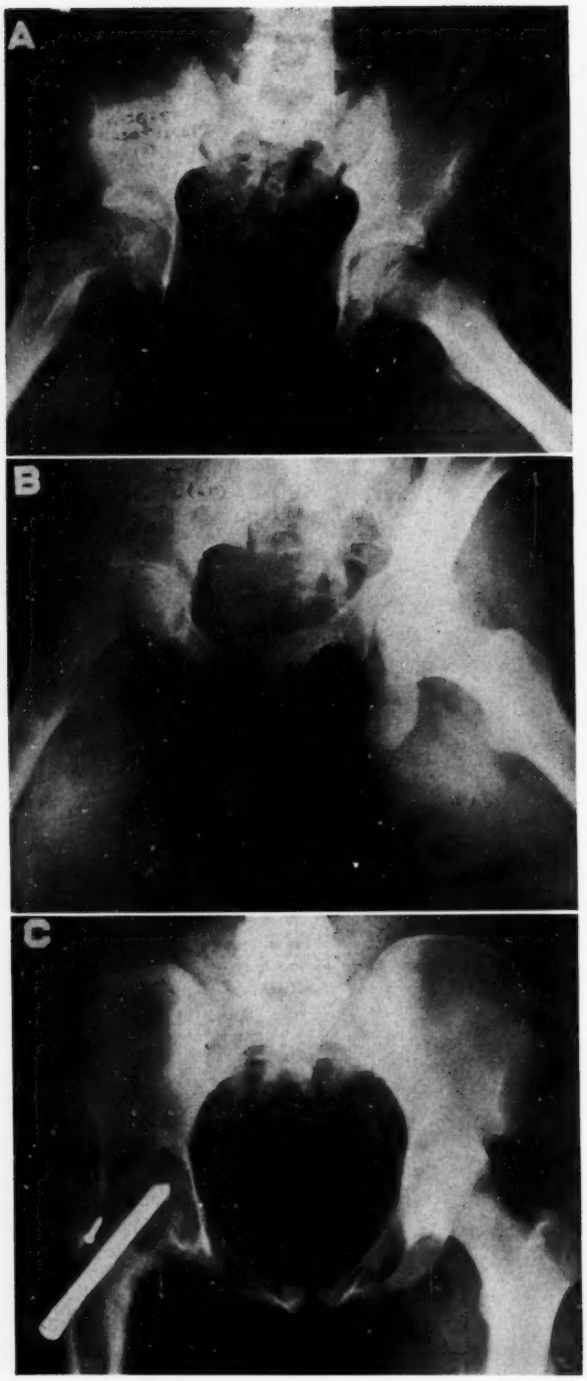

FIG. 2. A, slipped epiphysis in a fourteen year old girl. Joint space is thin. B, one year later. Hip was immobilized in spica cast for three months. Note atrophy, irregular thin joint space and abducted position. Hip is stiff and painful. C, x-ray taken three years after arthrodesis.

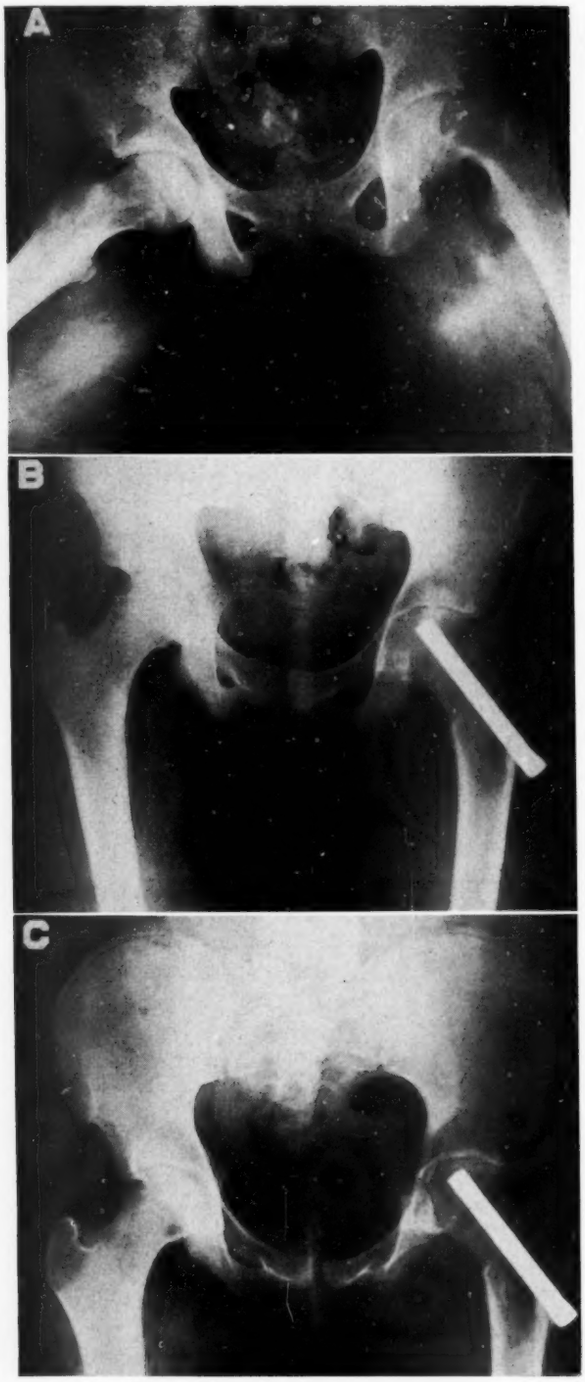

FIG. 3. A, slipped epiphysis in a sixteen year old girl with slightly narrowed joint space. B, one year after osteotomy and nailing. Thin joint space. Hip is painful and movement is restricted. C, fibrous ankylosis of hip. (Patient has since undergone unsuccessful arthroplasty and finally arthrodesis.)

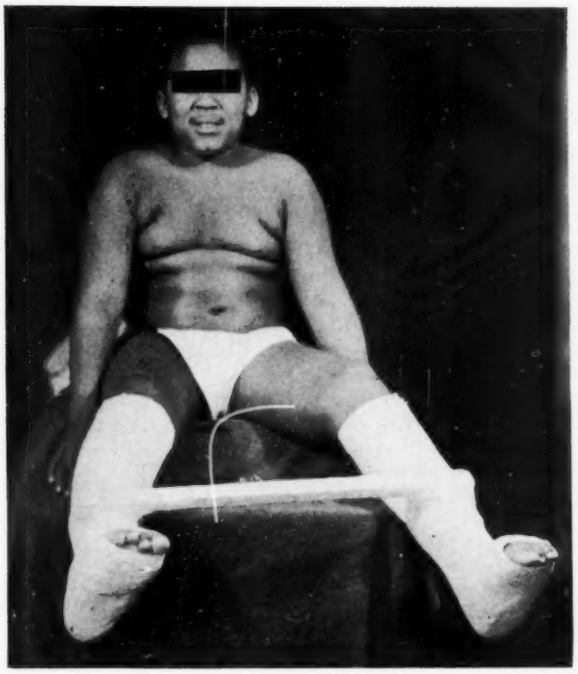

FIG. 4. Bilateral short leg casts for slipping femoral epiphysis.

FIG. 5. Active exercises while patient is under treatment.

covered legs over the head serve to maintain joint movement and muscle power. (Fig. 5.)

The casts are left on for about fourteen weeks. An additional two weeks of non-weight-bearing exercises are given to strengthen the below-knee muscles before guarded weight bearing is started with arch support shoes and crutches. All patients who have been non-weight-bearing for a time have a calcaneal or heel-walker type of gait until their calf muscles are sufficiently well developed for them to raise their weight on the ball of the foot. This means that special attention to strengthen the calf muscles* will shorten the "limping time." Crutches are usually discarded within a month after removal of the cast. Full athletic activity (football, basketball, etc.) is not permitted until there is satisfactory evidence of epiphysial closure.

RESULTS

Since the slightest incongruity of hip joint surfaces is apt to result in long-delayed osteoarthritis, there can be no real end result study on patients with slipped femoral epiphyses until several decades have elapsed after epiphysial closure.

* Jumping rope is a very good exercise for this purpose.

The problem of evaluating results is further complicated by the wide variation so commonly observed between functional results and x-ray appearances. In other words, a hip which looks pretty terrible in the x-ray may be serving its owner quite faithfully and painlessly. In an effort to evaluate our simple method of treatment, one of us (W. W.) questioned, examined and x-rayed thirty-two patients treated with this method (thirty-five hips involved). The only patients included in the study are those whose proximal femoral epiphysial plate is closed. In this rather limited sense it can be considered an end result study inasmuch as no further slipping can possibly occur.

We were quite pleased to find that under simple cast therapy all femoral heads had healed *in situ*. In other words, there was no instance of further slipping once treatment was instituted nor was there any case of avascular necrosis. Sixteen hips (45 per cent) were for all practical purposes normal, there being normal or almost normal movement, strength and endurance with no pain. Fourteen hips (39.9 per cent) which showed some limitation of movement (usually internal rotation and flexion) but with no pain and good strength and endurance were called good. In five hips (14 per cent) there was a sufficient

FIG. 6. A and B, x-rays of a thirteen year old boy. Note moderate slip on left; treated in casts three months. C and D, seven years later; perfect functional result.

degree of pain, stiffness, lack of strength or endurance to produce a poor result. In older children, premature epiphysial closure is often well inaugurated by the time the casts are removed. Remodeling of the head and neck (Figs. 6 and 7) will take place to a certain extent, especially in the younger children. A small pyramid-shaped osseous eminence is always present on the anterior surface of the neck when the slip has amounted to ½ cm. or more, representing the area where the slip occurred.

The degree of residual coxa vara depends not only upon the degree of the original slip but upon the age of the patient and the length of time the epiphysial plate remained open after the slip occurred. Early closure naturally results in a shorter neck.

CONCLUSIONS

1. Slipping proximal femoral epiphyses, when relieved of weight bearing and external rotary stresses, will heal *in situ*.

2. Short leg casts fastened together so as to hold the legs abducted and internally rotated accomplished the purpose very satisfactorily.

3. Thirty-five hips have been treated in this way without any further slip occurring on resumption of weight bearing. Thirty hips (85 per cent) are considered satisfactory.

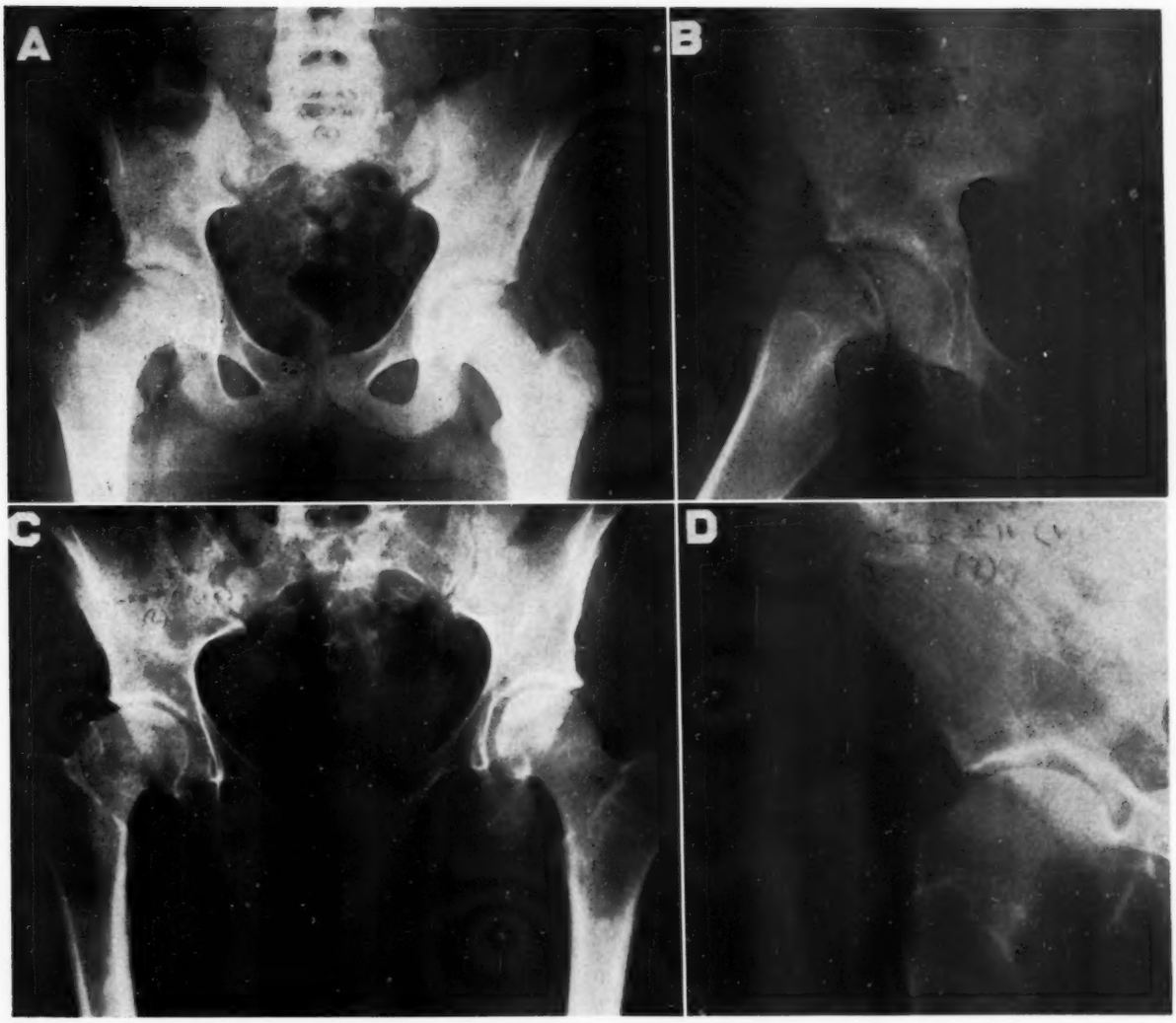

FIG. 7. A and B, x-rays of a twelve year old girl treated in casts three months. E and D, eleven years later; perfect functional result. Patient now works eight hours daily as an operating room nurse.

4. Premature closure of the epiphysial plate will occur in some cases.

5. An occasional patient with slipped femoral epiphysis will also have a fibrous ankylosing process in the same hip (arthrofibrosis).

6. Immobilization of the hip joint (spica cast) is unnecessary and contraindicated.

7. Insertion of nails or pins, cervical osteotomies and epiphysiodeses are difficult technical procedures with many potential complications. These dramatic methods may yield excellent results in the hands of orthopedic surgeons who have large numbers of patients and thus become proficient in these technics. However, slipping femoral epiphysis is a rare affliction. The surgeon in the general practice of orthopedics sees but an occasional case. We believe that these children will in the long run be better off if treated in the conservative way outlined herein.

Replacement Prostheses in Shoulder Injuries

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Read at the Meeting of the California Medical Association, San Francisco, California, May 2, 1955.

THE head of the humerus is an important unit in the complicated movements of the shoulder-arm complex, and its removal causes major disability. The end result is either a flail

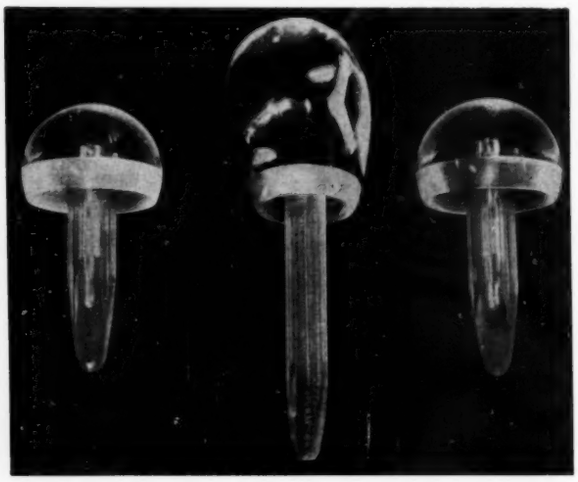

FIG. 1. Judet acrylic shoulder prosthesis flanked by two small Judet hip prostheses. The shoulder prosthesis is replica of humeral head, anatomic neck and a section of shaft. It contains a tunnel for the attachment of rotator cuff elements.

arm or fibrous ankylosis. Robert and Jean Judet, co-designers of the acrylic femoral head, were quick to realize the need of an endoprosthesis for the severely damaged proximal humerus. The first shoulder arthroplasty (endoprosthesis) was performed by them in 1947, and they have since reported seventeen such operations. Eleven were for traumatic lesions, five for tuberculosis siccus and one for ankylosis following rheumatoid arthritis.

In this country little attention has been paid to replacement therapy for the irreparably damaged humeral head. Instead, the head is removed and then the raw proximal end of the humerus is expected to fill its repository and to perform the function of the head. Observation of patients so treated provides internal and external evidence to support the fallacy of this reasoning. Sacrificing the head of the humerus is hemisecting the shoulder joint. Because the normal anatomy is grossly altered, the dynamics of the joint are permanently deranged. In 1951 Krueger[5] described a case of aseptic necrosis of the proximal humerus in which he substituted a vitallium® replica for the diseased part. He reported that the final result was very good.

This discussion is mainly concerned with fracture-dislocation of the shoulder where the fracture involves the anatomic neck and the blood supply to the head has been lost. The brothers Judet have shown that treatment by endoprosthesis is not limited to a single lesion of the proximal humerus, but that other lesions of the area are adaptable to it. Fracture of the anatomic neck with dislocation has been treated either with shoulder fusion or by sacrificing the head and attempting to hold the stump in the glenoid cavity. Simple hemisection has enjoyed greater popularity than fusion.

The Judets first described the use of the acrylic humeral prosthesis for severely comminuted fractures of the head, surgical neck and upper shaft. Their apparatus is a replica of head, neck and a short portion of the shaft. On its lateral aspect it has a tunnel large enough to receive heavy suture material, so the rotator cuff muscles may be attached to the prosthesis. (Fig. 1.) This prosthesis is too large for fracture dislocations of the anatomic neck. Its use requires discarding the bone attachments of the rotator cuff elements, and removing more bone than necessary. Instead, the small hip prosthesis (41–60 or 43–60) of Judet is suitable. Here the procedure calls for a simple redressing of the stump and removing a few small bony fragments from the shaft side of the fracture. The rotator cuff attachments are spared and can be placed so that they will unite with the shaft.

In our cases the small hip prosthesis was used and served quite satisfactorily. Today the smaller shoulder prosthesis is available, but it was not at hand when these cases were treated. Whether one uses the small hip pros-

thesis or the newer small shoulder prosthesis is of little consequence. The shoulder joint is receptive to either, and final results should be uniformly parallel.

DYNAMIC ANATOMY OF SHOULDER-ARM COMPLEX

Duchene, Steindler, Inman, Moseley, and Codman have contributed to the kinesiatrics of the shoulder-arm complex. They have shown how the strength and action of its muscles change when the humerus changes its position in relation to the glenoid.

1. *The deltoid* is the prime abductor of the shoulder, and its range is limited by 90 degrees or to the horizontal. Each of its three parts is a separate functional unit. These are: the anterior or clavicular, the middle or acromial, and the posterior or spinous.

The anterior fibers have an abductory power that is increased by external rotation. Like other shoulder muscles, their action and power are changed as the humerus changes its position. With the arm abducted, the clavicular fibers are forward flexors; but as the arm is adducted, they become strong inward rotators. Therefore their power of internal rotation decreases as the humerus is abducted and flexed.

The middle or acromial fibers are straight abductors.

The posterior or spinous portion is a potent extensor and, with the humerus adducted, it externally rotates. As the arm is abducted, its external rotation power is lost. With the arm in normal position the posterior fibers are adductors, so any change in humeroglenoid relationship changes the action and power of the three divisions. For example, with the arm at the side, the anterior and posterior fibers are rotators (the former internal and the latter external); but as abduction comes into play, more and more fibers become abductors at the expense of rotation. When the arm is in abduction, the spinous part becomes an extensor and the clavicular part assumes the powers of a flexor.

2. *The rotator cuff* is formed by the attachments of the supraspinatus, infraspinatus, teres minor and subscapularis.

The supraspinatus will be discussed separately because of its clinical importance. It has several actions. It holds the humeral head in contact with the glenoid and initiates the first 30 degrees of abduction. At that point the middle deltoid reinforces and takes over this action. The supraspinatus assists in flexion-abduction, and external rotation of the arm. After the humerus has passed 25 degrees of abduction, the supraspinatus loses its power of abduction.

The rotator cuff triad consists of the infraspinatus, teres minor and subscapularis. The infraspinatus and the teres minor form a functional and structural unit. This unit externally rotates the arm through a range of motion 45 degrees from neutral or 90 degrees from complete internal rotation. Its rotatory power changes to extensory power in proportion to the amount of abduction. During abduction and adduction these muscles provide the rotation (with the counterbalancing action of the subscapularis) so necessary for smooth to-and-fro motion of the hand as it moves from side to side. The subscapularis, an antagonist of the infraspinatus–teres minor unit, is large and strong enough to balance the posteriorly placed infraspinatus–teres minor combine. The subscapularis is an internal rotator, and this is maximal when the arm is adducted. As abduction proceeds, the rotatory power decreases in favor of flexion.

The rotator cuff triad plays an important role in the cephalocaudad motion of the head against the glenoid when the humerus is abducted and adducted. This action is reinforced by the supraspinatus, the long tendons of the biceps and triceps, and the coracobrachialis.

3. *Related muscles:* The biceps, especially the intra-articular portion of the long tendon, assists the cuff group in depressing the humeral head when resistance is exerted on the hand during attempted forward elevation of the arm. The long head is an abductor and its forward-flexing ability increases with abduction. The short head is an adductor and inward rotator. The inward rotation changes to flexion when the arm is abducted.

The coracobrachialis has the same action as the short head of the biceps.

The long head of the triceps is an abductor, and keeps this action regardless of position. With help from the coracobrachialis, it prevents downward subluxation of the humeral head by lifting upward when the arm is being adducted from an elevated position by the strong combined action of the latissimus dorsi and pectoralis major.

The latissimus dorsi and teres major are strong inward rotators in all positions. Their

extensory power is weak but this is somewhat increased by abduction. When the humerus is abducted, their adductory power is increased.

The pectoralis major has two parts—clavicular and costosternal. The clavicular is a forward flexor in all positions. This power is greatest with the arm in neutral position, but it decreases as the arm passes 45 degrees of abduction. From this point on flexor power gradually gives way to abduction. The costosternal segment is always a strong adductor. Its flexor power is also formidable.

The intricate anatomy of the shoulder-arm complex shows how the shoulder mechanics are disturbed by decreasing the distance between the origin and attachment of its motor elements. The removal of the head shortens the humerus and that makes the soft tissues redundant. Then the humeroglenoid stability is lost and shoulder motion cannot be carried out in a normal way. The reason for the instability is because the bulbous termination of the shaft (held in some contact with the glenoid in all ranges of motion) is not present to add its support. Therefore the relatively elongated musculature and the lack of the head create the disability so often seen after the hemisection operation. It is easy to see how pain and weakness follow and how the flexor power of the elbow is reduced. With the elbow extended, the lifting power of the forearm depends in part on the normal length of the humerus plus the action of the depressors of the head. Without the humeral head, the lever arm is foreshortened and the shoulder is unstable. Then the lifting power of the forearm is dissipated by the simple action of flexing forearm on arm.

INDICATIONS

Fracture of the anatomic neck with dislocation where the vascular supply of head has been destroyed is a prime indication for endoprosthesis. Open reduction to replace the necrotic head serves no useful purpose. It must be discarded. Substituting an endoprosthesis for the necrotic head maintains humeral length and restores the relationship of the shoulder joint.

Replacement prosthesis has been used successfully by the brothers Judet in severely comminuted fractures of the head and upper shaft. Here the longer prosthesis containing the tunnel should be used.

In the elderly patient fracture through the surgical neck with marked displacement is a situation for which prosthesis should be considered. Treatment by closed method means weeks spent in traction, and also there may be difficulty or failure in holding reduction. The use of endoprosthesis will permit these individuals to be up and about in a matter of days following surgery, and eliminate several weeks of recumbency. The surgeon should not procrastinate but should operate as soon as conditions permit. By early surgery the atrophic changes following trauma are greatly decreased.

SURGICAL PROCEDURE

The operation is not difficult. The hardest part is removing the head and any free bony fragments that might be present. The operator makes the incision in the deltopectoral fold. It starts at the clavicle, just medial to the tip of the coracoid process, and courses downward about 5 inches, following the curve of the deltoid. The anterior fibers of the deltoid are divided in line with the skin incision ½ inch lateral to the medial border of the anterior deltoid. Medial retraction of this narrow strip of deltoid protects the cephalic vein and deltoid branch of the thoracoacromial artery. The main deltoid fibers are retracted lateralward, exposing from above downward the coracoid process, the anterior aspect of the capsule of the shoulder, the combined coracobrachialis, the short head of biceps and pectoralis major. If it is required, the conjoined coracobrachialis-biceps tendon can be severed just inferior to its attachment and reflected. This exposes the anteroinferior capsule. In fracture dislocation the head is removed; however, it should be saved to help the surgeon choose the correct prosthesis. Then the shaft stump is passed through the capsular rent and carefully redressed by bone-cutting forceps or rongeurs. The surgeon should not remove any more bone than necessary. The bony attachment of the rotator cuff group should be identified but not removed. Then an endoprosthesis of suitable size is firmly seated onto the stump of the shaft in the usual manner. Before final seating it may be necessary to displace the rotator cuff attachments to make room for the hemispherical part of the endoprosthesis. After seating is complete, the cuff fragments are pulled into intimate contact with the head. The raw bone surfaces of

rotator cuff and humeral shaft must be in contact. Then the shaft with its endoprosthesis is reduced, and the arm held in 45 degrees abduction and 45 degrees forward flexion (salute position). This position uniformly relaxes the shoulder capsule and permits the rotator cuff to retain its position with the humeral shaft. The capsule should be sutured if possible. If the conjoined coracobrachialis-biceps tendon has been severed, it should be sutured. Closure of the wound is made in the usual manner and the arm must be held in the salute position until a plaster shoulder spica has been applied. In one of our cases the arm was placed in an airplane splint; the result was dislocation. The spica is worn for four weeks.

POSTOPERATIVE CARE

This part of the treatment depends upon the individual and the type of trauma. In the young, active patient a few physiotherapy treatments with instruction in progressive exercise will be all that is needed. In the older, weaker person physiotherapy should be governed by his requirements. The patient should not bring the arm into the posterior diagonal plane until at least eight weeks after surgery. Movement in the forward diagonal plane is safe and should be encouraged.

COMPLICATIONS

In contrast to the many complications in similar hip surgery, few are encountered in the shoulder procedure. This is easy to understand when one considers the difference of the joints, and the greater demand placed upon the weight-bearing hip. In the shoulder the principal complications are: dislocation of the prosthesis and failure of union between rotator cuff and humeral shaft. These can be prevented by immobilizing the extremity in a shoulder spica. Subluxations, repeated dislocations, resorption of the supporting bony structures, tearing out of the prosthesis and other sundry complications encountered in the hip case need not be expected in the shoulder case. The non-weight-bearing, loosely coupled shoulder joint has only a fleeting contact between the opposing cartilaginous surfaces at any given time. From this alone one can justifiably expect a better result in the use of shoulder endoprosthesis.

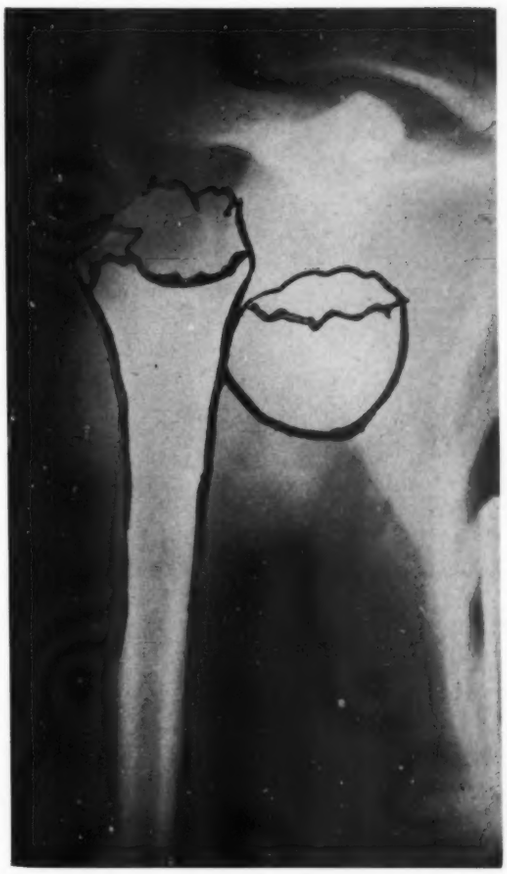

FIG. 2. Case 1. Fracture of anatomic neck with dislocation of the head. The humeral head lies anteroinferior to the glenoid. The bony attachment of rotator cuff is also fractured and displaced. Humeral shaft and head are outlined.

CASE REPORTS

CASE 1. The patient, a thirty-eight year old woman, sustained a fracture of the anatomic neck of the humerus with dislocation. (Fig. 2.) Closed reduction was unsuccessful. Some days later she was operated upon and the humeral head was found inferior to the anterior rim of the glenoid. It was entirely covered by articular cartilage and had lost its circulation. After the stump was delivered through the capsular rent, it was discovered that should the large shoulder prosthesis (heretofore described) be used, considerable bone, including the rotor cuff attachments, would have to be sacrificed. Instead, a small femoral prosthesis (43–60) was employed. (Fig. 1.) Surgery was carried out as described in the paragraph on surgical procedure.

The patient wore a shoulder spica for four

FIG. 3. Case I. X-ray eight months following surgery shows the bony rotator cuff attachments firmly affixed to the shaft.

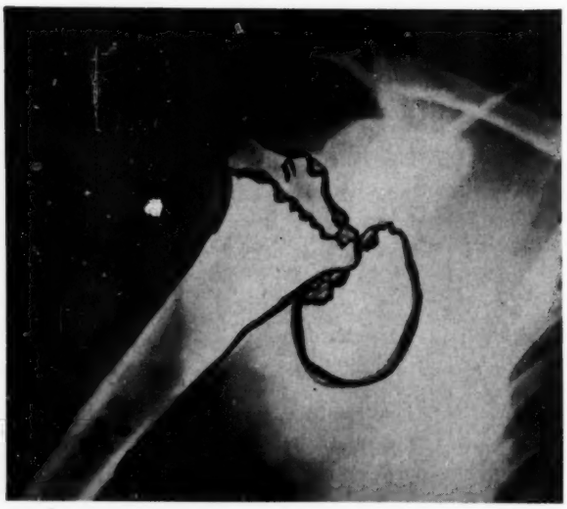

FIG. 4. Case II. Fracture through anatomic neck and bony attachment of rotator cuff elements. Head lies anteroinferior to glenoid. Fracture site and humeral head are outlined to clarify their relative positions. Almost identical findings noted as in roentgenograms of Case I (Figure 2).

weeks; and after it was removed, she was given extensive physiotherapy. In retrospect, it is now thought that the average case does not require prolonged physiotherapy. A few weeks of treatment to increase motion of the shoulder is usually enough. When last seen three years after surgery this patient had more than 80 per cent function of the shoulder-

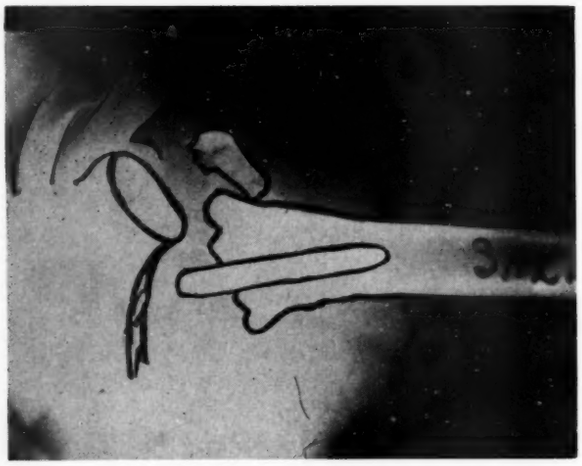

FIG. 5. Case II. Twenty days following surgery. Anteroinferior dislocation of prosthesis and displacement of tuberosities. Upper humeral shaft, humeroglenoid vault, bony attachments of rotator cuff and stem of prosthesis are outlined. Dislocation was reduced and has remained so.

arm complex, good strength and only slight discomfort after heavy work. She can perform all shoulder-arm functions in approximately the same degree as before injury. (Fig. 3.)

CASE II. The patient, a thirty-three year old man, sustained a fracture through the anatomic neck with dislocation. (Fig. 4.) He was operated upon and a small Judet hip prosthesis was used. Instead of applying a shoulder spica, an airplane splint was employed. Twenty days after surgery the prosthesis was found to be dislocated. (Fig. 5.) Under pentothal® anesthesia the dislocation was reduced by closed method and a plaster shoulder spica applied with the arm in the salute position. It was worn for four weeks. The patient was then instructed in active exercises to increase movement in the forward-diagonal plane. He regained motion quite rapidly, and one year after surgery he had 85 per cent restoration of function. He is able to perform all activities he was accustomed to carrying out previous to injury. He has no pain in the shoulder, but following very heavy work he has some discomfort.

Comments. In both cases there is normal stability of the shoulder, almost complete restoration of function in all planes of motion, and complete return of strength in the arm, forearm and hand. These results are in sharp contrast to those following simple hemisection. In hemisected cases, 70 per cent disability is

not unusual. Without the head, the shoulder is almost always unstable and there is pain after hard use. The painful stable shoulder is not a useful shoulder, nor is the pain-free, unstable shoulder useful.

SUMMARY AND CONCLUSIONS

Because of poor end results the use of replacement prosthesis in hip surgery is falling into disfavor. However, this need not be so in regard to the shoulder. The use of replacement prosthesis for the damaged humeral head should, in contrast to the hip, produce satisfactory results for two reasons: (1) The shoulder is not a weight-bearing joint, so it is not subjected to the stresses and strains attendant thereto. (2) The shoulder joint is loosely coupled and does not require atmospheric pressure to maintain its normal relationships; the area of contact between the opposing articular surfaces is comparatively small at any given point in the range of motion.

In those cases in which the humeral head must be sacrificed, its replacement by endoprosthesis does not detract in any way from future treatment as in similar surgery of the hip. On the contrary, it maintains the length of the humerus and this permits the muscles to maintain stability of the humeroglenoid joint.

The lack of sufficient cases denies the formation of firm statistical conclusions, so this presentation must be considered as a preliminary report. When a series of cases has been analyzed, it is quite likely that hemisection of the shoulder will be only a step in the treatment by replacement prosthesis. It is well within the realm of reasonable assumption (if the indications are strictly adhered to) that the results will be gratifying and that the apperception of future cases will set a new trend in treating this disabling injury.

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Purulent Pericarditis

MANAGEMENT WITH SURGICAL DRAINAGE AND ENZYMATIC DÉBRIDEMENT

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IN recent years the use of antibiotics has greatly altered both the incidence and treatment of purulent pericarditis. Where once this condition was a frequent complication of pneumococcal pneumonia, staphylococcus septicemia, meningococcemia and the like, nowadays cases rarely proceed to this stage. In 1941 Strieder and Sandusky[11] estimated the mortality to be 100 per cent in untreated cases of purulent pericarditis. This figure dropped to 50 per cent when pericardiostomy was performed. Since the advent of antibiotics, 70 per cent cures are possible.[9]

Purulent pericarditis can often be successfully managed by pericardicentesis and antibiotic therapy, including local instillation into the pericardium. With signs of uncontrolled infection or persistent cardiac tamponade, surgical drainage plays a prominent role. Occasionally the purulent exudate becomes thick and loculated, excluding the possibility of evacuation by irrigation. This problem can be overcome by the use of liquefying enzymes transforming the inspissated pus into a thin solution which drains easily. This lytic agent was developed by Tillet[12] from the Streptococcus hemolyticus, which elaborates both streptokinase and streptodornase in the growth phase of certain strains. Streptokinase appears to catalyze the transformation of plasminogen to plasmin, an active fibrinolysin in human plasma. Streptodornase liquefies desoxyribose nucleoprotein which with fibrin is a prominent constituent of pus, giving it a stringy, ropy, viscous quality.

The lytic principal prepared for commercial use (varidase®)† has been used in the treatment of purulent pericarditis on several occasions. Hunter,[5] and Goldsmith and Sterling[4] each reported one case in which varidase was injected into the pericardial cavity. Adie and Childress[1] and Menendez[8] reported one case each utilizing this agent in conjunction with pericardiostomy.

The following case of purulent pericarditis is reported to illustrate the successful use of varidase in draining thick, viscid pus which ordinarily could not be evacuated despite adequate pericardiostomy.

CASE REPORT

D. S., a twenty-six year old white man, was involved in an automobile accident on October 24, 1952, when the car that he was driving struck a telephone pole. He was taken to a local civilian hospital and given morphine for pain. No x-rays were taken. His condition became progressively worse, and on the morning of October 27th, three days after his injury, he was transferred to the Fort Campbell Army Hospital. At that time he showed signs of morphine toxicity with pinpoint pupils, extreme drowsiness and 6 to 8 respirations per minute. His skin was cold and clammy. Dullness to percussion and decreased breath sounds were noted over the entire right hemithorax. X-ray of the chest showed multiple fractures of the fourth to eighth ribs on the right, with marked depression of the fragments. There was considerable subcutaneous emphysema over the right chest extending across the abdomen and upward to the neck. Fluid obliterated the entire right pleural cavity with marked shift of the mediastinum to the left. The hematocrit was 26 and the hemoglobin was 9 gm. A thoracentesis was performed, removing 1,000 ml. of bright red blood. Despite transfusions of whole blood and supportive therapy, the patient's condition progressively deteriorated.

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The subcutaneous emphysema increased and it became obvious that there was active bleeding into the right pleural cavity.

In the operating room a second thoracentesis yielded 250 ml. of bright red blood. Because of excessive bronchial secretions and increasing dyspnea, bronchoscopy was done under local topical anesthesia. During this prodedure the patient became cyanotic and spontaneous respirations ceased for about five minutes. Artificial respiration and oxygen were required. Despite adequate blood replacement, signs of hemorrhage and shock persisted; exploratory thoracotomy was therefore elected.

Under ether-oxygen endotracheal anesthesia through a posterolateral approach the entire fractured sixth rib was excised. About 300 ml. of both clotted and fresh blood were evacuated from the pleural cavity. The right lung was partially atelectatic, especially in the middle and lower lobes. An extensive tripartite laceration of the lower lobe almost completely divided it into three segments and extended into the hilum. Following minimal manipulation of the lower lobe in an attempt to estimate the degree of laceration, severe hemorrhage suddenly occurred from this area where a blood clot apparently was dislodged from the lacerated hilar vessels. An estimated 2,000 ml. of blood were lost before the bleeding could be controlled with a tourniquet applied about the hilum. The blood pressure was unobtainable and the cardiac rhythm was irregular. Further inspection of the wound revealed that the old laceration of the hilum had completely divided the main bronchus to the middle lobe and involved the inferior pulmonary vein. Since the complete extent could not be accurately determined and the patient's condition was then so precarious, a rapid total pneumonectomy was performed, dividing the hilar vessels and bronchi between clamps and suture ligatures. Further profuse hemorrhage resulted which was controlled with ligatures and oxycel® packing. The wound was rapidly closed in layers.

At the conclusion of the operation the patient's blood pressure was 130/80, pulse 120 and respirations 24. Bronchoscopy was done, aspirating large amounts of blood-tinged mucus from the left bronchus. The left lung was fully aerated and the skin was warm and pink. The patient had received a total of 6,000 ml. of whole blood during the operative procedure. An additional 1,000 ml. of blood were administered during the first twelve hours postoperatively.

The following day the patient's condition was satisfactory and his urinary output was adequate, but he exhibited intermittent twitchings of his lower extremities. On the second postoperative day his temperature spiked to 40°C. X-rays showed no evidence of atelectasis of the lung; there was considerable serum accumulating in the right pleural cavity. The patient grew increasingly dyspneic, so the catheter which had been inserted in the right chest cavity was opened and the accumulated serum was allowed to drain. Respirations immediately became less labored. Penicillin and streptomycin were instilled daily into the pleural cavity. Culture of the pleural fluid showed hemolytic staphylococcus aureus.

On the third postoperative day the patient was completely disoriented, and spastic paralysis developed of the left arm and leg. The neurosurgeons believed this to be a result of cerebral concussion following the motor accident, but cerebral damage secondary to the prolonged hypotension during the operation was also considered a possibility. The patient continued to have a febrile course and remained irrational. By the eleventh postoperative day the drainage from the pleural cavity was grossly purulent and cultures continued to show hemolytic staphylococcus aureus sensitive only to bacitracin and chloromycetin.® On November 10th, the fourteenth postoperative day, the patient was taken to the operating room where under local procaine anesthesia a portion of the tenth rib was resected at the posterior axillary line, draining approximately 200 ml. of grossly purulent exudate from the right pleural cavity. This stoma was kept open with four large rubber tubes, and the pleural cavity was irrigated twice daily with bacitracin, 25,000 units in 100 cc. of saline. Chloromycetin, 250 mg., was given every six hours by mouth.

On November 12th, sixteen days following pneumonectomy and two days after thoracostomy, a pericardial friction rub was audible. At this time the patient's temperature was 38.6°C., pulse 120 and respirations 30. He began expectorating blood-tinged mucus. By November 15th the friction rub had become less distinct but the neck veins were distended and there was increasing cyanosis. X-rays of the chest revealed some increase in the size of

the heart shadow. The heart sounds, however, were quite distinct. On November 18th there was further evidence of cardiac tamponade with indistinct heart sounds, marked distention of the neck veins and cyanosis at rest in spite of oxygen per nasal catheter. The friction rub was scarcely audible. The blood pressure was 90/62 and pulse 150. In an effort to relieve the tamponade, pericardicentesis was performed through a left subxiphoid approach, taking extreme care to avoid any contamination of the left pleural cavity. At this time 200 ml. of purulent fluid were removed. However, there was very little improvement. Subsequent culture of the exudate revealed Pseudomonas aeruginosa showing poor inhibition to terramycin® and chloromycetin, and hemolytic staphylococcus aureus sensitive to chloromycetin and bacitracin. By the following morning the patient's condition had rapidly deteriorated, his pulse became quite irregular and cyanosis increased. Another pericardicentesis was performed, removing 500 ml. of red-orange purulent exudate without any demonstrable improvement in his condition. Subsequently, on the afternoon of November 19th, he was taken to the operating room where pericardiostomy was performed under local procaine anesthesia. To avoid any possible contamination of the left pleural cavity, drainage was effected by removing the greater portion of the body of the sternum and creating an adequate stoma measuring about 3 by 6 cm. in dimension. The parietal pericardium was markedly edematous, measuring about 1 cm. in thickness. About 800 ml. of purulent exudate were evacuated from the enormously dilated pericardial cavity. The patient's condition improved immediately. His pulse became regular and respirations were less labored. His blood pressure rose to 120/80, and in a short interval his temperature dropped to 37.7°C. X-rays of the chest at this time showed a markedly enlarged and fixed pericardial sac compressing the left lung; however, the heart shadow was normal in size and could be outlined within the confines of the pericardial sac. On the first day postoperatively rales developed in the left side of the chest as well as some dependent edema which was controlled with mercuhydrin.®

Considerable quantities of thick pus continued to drain through the pericardiostomy stoma. The pericardial cavity was irrigated daily with bacitracin, 25,000 units in normal saline, through a small rubber catheter inserted carefully behind the heart and removed immediately following irrigation to prevent pressure necrosis or cardiac irritation.

On November 23rd, the fourth day following pericardiostomy, coarse rales again developed in the left lung and the pulse became weak, thready and irregular. By this time the purulent exudate in the pericardial cavity had become so thick and tenacious it would not drain in spite of frequent irrigations and postural drainage. This thick exudate within the pericardial sac encased the heart and was obviously restricting adequate filling of the cardiac chambers. Signs of recurrent cardiac tamponade were becoming increasingly evident. Subsequently, a solution containing 30,000 units of streptokinase and 10,000 units of streptodornase with bacitracin was instilled into the pericardial cavity. The results were dramatic. The exudate rapidly liquefied and drained profusely from the pericardial cavity. Respirations were less labored, the pulse became regular and strong, and the pulse pressure increased. Postural drainage was effected by inclining the torso acutely forward with the patient in a sitting position, so that the pus would drain from the posterior portions of the pericardium. The pericardial cavity was irrigated daily through a catheter inserted in all available confines of the sac, instilling 100,000 units of streptokinase and 25,000 units of streptodornase containing 25,000 units of bacitracin. Profuse drainage continued through both pericardiostomy and thoracotomy stomas. Cultures of the pericardial exudate at this time continued to grow out hemolytic staphylococcus aureus sensitive to chloromycetin and bacitracin, and Ps. aeruginosa which showed no inhibition to all antibiotics. Cultures of pleural exudate grew out Ps. aeruginosa, hemolytic staphylococcus aureus and unidentified gram-negative bacilli. A small bronchopleural fistula had developed on the stump of the right bronchus which caused paroxysms of coughing and cyanosis if the patient turned on his left side after irrigations of the pleural cavity. Otherwise this caused no other immediate problem. By November 29th the patient had regained some motion of his left leg and arm. Although he was irrational most of the time, he had occasional short periods of coherency. Physical therapy was concentrated on his left arm and leg, and with assistance he was able to walk short distances.

Approximately six weeks after pneumonectomy the patient was completely oriented and was able to recall events up to the time of his accident but had no memory of events occurring in the postoperative period. Perichrondritis developed at the exposed ends of the costal cartilages near the margin of the pericardiostomy stoma. Moderate amounts of thin, greenish yellow pus drained around the cartilages, and by virtue of its position would drain into the pericardial cavity. The exposed ends of costal cartilages were removed with a rongeur and saline dressings were applied to the wound. The exudate gradually diminished. There was very little drainage from the pericardial cavity itself at this time; however, the irrigations were continued daily through a rubber catheter using 20,000 units of streptokinase and 50,000 units of streptodornase containing 25,000 units of bacitracin in 30 cc. of physiologic saline.

Up to this period digital exploration of the pericardial cavity was performed at intervals to break up any adhesions between parietal and visceral pericardium. An electrocardiograph showed sinus tachycardia and flat T waves. By December 22nd the pericardial sac had contracted somewhat and a finger could barely be inserted between the heart and the pericardial wall. The cardiac thrust appeared somewhat diminished as viewed through the pericardiostomy stoma. A serial ballistocardiographic record was obtained and failed to show any significant change over the observation period to indicate any decrease in cardiac output. QRS complexes of the electrocardiograph were superimposed for timing purposes. A sinus tachycardia persisted with some flattening of T waves in lead II. Venous pressure, however, was normal.

The patient continued to have a spiking fever to 38.8°C. daily, and his weight dropped to 91 pounds in contrast to 140 pounds which he weighed prior to his accident. Although he had a voracious appetite, he was unable to gain weight in spite of dietary supplements. The pericardiostomy stoma began to close slowly with granulation tissue. Drainage from this cavity ceased completely although a small amount of exudate from the granulating wound edges and, presumably, from the perichondritis continued to drain dependently into the stoma. Moderate purulent exudate drained through the open thoracotomy stoma. With daily physiotherapy he regained complete motion of his arm and leg but lacked coordination of his left arm.

By March 11th the pericardiostomy stoma was very small and almost completely bridged over with granulation tissue. The heart was shifted to the left, and the pericardial sac which was enormously dilated initially had regained normal size. For administrative reasons the patient was transferred to a Veterans Administration Hospital at this time. Subsequently, closure of the bronchopleural fistula was accomplished by the Schede type of thoracoplasty. The sternal defect resulting from the pericardiostomy had granulated closed and was covered with split-thickness grafts. The patient gained 26 pounds in weight and after extensive physiotherapy was able to walk long distances unassisted. Up to the present time there has been no clinical evidence of pericarditis.

COMMENTS

In a survey of all types of acute pericarditis, 35 per cent were due to the pneumococcus while 30 per cent were a complication of rheumatic fever.[2] Staphylococcus, streptococcus and the tubercle bacillus accounted for 15 per cent of cases. The remaining 20 per cent had been non-infectious and included those cases occurring as a terminal event in uremia, diabetes, anemia, leukemia and coronary thrombosis. Other organisms as Hemophilus influenzae, Eschericha coli and the typhoid-paratyphoid group have been noted as pathogenic agents.[7]

Purulent pericarditis most commonly follows affections of the chest such as pneumonia or empyema.[11] Treatment of this complication must then entail treating associated conditions. Therefore the prognosis will depend upon the nature and severity of the primary process involved. Sears[10] found that 5 per cent of patients died when pericarditis developed secondary to rheumatic fever, whereas 80 per cent died when it was secondary to other conditions such as empyema, pneumonia or septicemia.

Death from acute purulent pericarditis often results from inadequate drainage since large amounts of exudate cause pressure symptoms and tamponade. Once the pericarditis has been suspected clinically and radiographically, aspiration is the only means of confirming the diagnosis. The anterior apical or subxiphoid routes for pericardicentesis are preferred.[6] With our patient the latter route was used to prevent

contamination of the left pleural cavity. When a purulent exudate is encountered, all pus should be withdrawn, relieving the tamponade and lowering the risk of surgery. Culture and sensitivity studies should be determined on this material, properly identifying organisms so that appropriate antibiotic therapy may be instituted. Systemic antibiotics cannot be depended upon to handle this condition entirely, so local instillation of antibiotic solutions is employed. These measures combined with paracentesis may be sufficient. The dangers of repeated aspiration must be stressed. If uncontrolled infection or cardiac compression persist, pericardiostomy is indicated. The surgical approach may be intercostal, trans-sternal, posterior, epigastric or by resection of one or more costal cartilages. The trans-sternal method was used in this case to avoid contamination of the left pleural cavity and the remaining lung.

Once dependent drainage has been established, the pericardial cavity is usually explored digitally to break up any pockets and remove large clots of pus. The cavity can be irrigated with saline by means of a soft rubber catheter slipped behind the heart. The catheter is removed from the pericardial sac in order to prevent any pressure necrosis, but a soft Penrose drain may be used to aid drainage.

A saline solution containing 100,000 units of streptokinase and 25,000 units of streptodornase can be instilled daily through a catheter. Appropriate antibiotics may be added. The enzymes, by lysing fibrin and digesting the waste products of the exudate, liquefy the material and promote drainage. With our patient the pus had become so thick and viscid it could not drain, and cardiac tamponade resulted although adequate pericardiostomy had been established. It is important that the increased fluid resulting from varidase instillation be allowed to drain. If this fluid is not removed, further cardiac compression may result. It is helpful to have the patient sit on the edge of the bed or chair, supported and leaning forward at approximately a 45 degree angle. This position allows the liquefied pus to drain from the posterior areas of the pericardial cavity. The pumping motion of the heart also aids in the egress of the pus.

While drainage persists, granulation tissue and fibrinous adhesions over the stoma can be broken up. When drainage ceases and the wound is granulating, secondary closure is done. Rotation skin flap or postage stamp grafts may be necessary.

There was some concern that these granulations and adhesions from the edge of the stoma to the heart might limit the cardiac thrust or that the thickened pericardium would have a constrictive effect. This was not evident by ballistocardiographic studies or venous pressure determinations and has not occurred up to this date. The long term result remains to be seen. However, in a report of thirty-seven pericardiectomies for chronic constrictive pericarditis,[3] none were secondary to suppurative pericarditis. The previous high mortality for this condition may be the reason why constrictive changes did not eventually occur.

SUMMARY

Purulent pericarditis is treated with repeated paracentesis combined with the local and parenteral use of appropriate antibiotics. Surgical drainage must be established when these measures are ineffective. As an adjunct to this method, irrigation of the pericardial sac with streptokinase and streptodornase will liquefy pus and facilitate drainage. A case which illustrates this fact has been reported.

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Massive Bleeding from Diverticulosis of the Colon

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DURING recent years there has been an increasing interest in diverticulosis and diverticulitis of the colon. This is probably a natural result of the aging of our population and of the fact that we are seeing more and more patients in the age period when diverticulosis reaches its highest incidence and its complications become more prevalent. In 1900 only one person in twenty-five in this country was sixty-five years old or older; the present figure is one in twelve; and, if this trend is projected to the year 1975, the figure will be one in seven.[1] It is estimated that 5 per cent of all people over forty have diverticulosis. It is estimated further that 15 to 20 per cent of all people with diverticulosis will develop diverticulitis, and that approximately 20 per cent of those with diverticulitis will develop complications requiring surgery.[2] It is therefore safe to assume that, as time goes on, we will all be seeing with increasing frequency these elderly patients with complicated diverticular disease.

Much has been written during the last decade about the surgical treatment of the more common complications of diverticulitis. These have usually been listed under the heading of: (1) perforation, (2) obstruction, (3) sinus and fistula formation, and (4) masked carcinoma. Moreover, the treatment of these well recognized complications of diverticulitis has become more or less standardized, there being a definite trend toward resection. The generally accepted procedure for perforations, obstructions and fistulas is primary colostomy, usually made in the right transverse colon, followed several months later by resection of the involved segment of colon, usually the sigmoid. Closure of the colostomy is sometimes done then, but most authors advise that it be deferred and done at a third stage.

On the other hand, very little has been written about the complications being discussed in this paper, namely, massive bleeding. Everybody now recognizes that the patient with diverticulitis may bleed, and most authorities now agree that bleeding occurs about as frequently in diverticulitis as in carcinoma. A review of the literature[2–10] would apparently place this figure at somewhere around 20 per cent of cases. It should be remembered, however, that this figure includes many cases with only moderate to minimal bleeding. When we consider the incidence of massive bleeding, to the extent that transfusion becomes necessary, the figure drops to the neighborhood of 4 per cent.[3–5,7,8,11] Most writers are now ready to concede that massive bleeding does occur in diverticulitis and that it occasionally may be the major indication for surgery.

That massive bleeding may also occur in apparently uncomplicated cases of diverticulosis has not received such universal acceptance. When recently confronted with three such cases I was impressed by the sparsity of similar reports in the literature, and found very little recorded experience to use as a guide in their management.

Probably the earliest report to stimulate interest in this problem was by Stone in 1944.[12] He reported a follow-up of seventy-two patients in whom massive rectal bleeding had occurred in the absence of any vomiting of blood or antecedent symptoms, and was able to find only eight cases showing diverticulosis. Although the diverticular disease was presumably the source of the bleeding in these eight cases, there was no way to prove it definitely.

Almost all surgeons with wide clinical experience can recall patients who have presented themselves with massive hemorrhage from the lower bowel, and who on subsequent investigation by sigmoidoscopic examination and contrast barium enema failed to show any lesion to account for the bleeding. Furthermore, many of these patients have continued to enjoy good health without subsequent recurrence of

the bleeding. It is for this reason that most authors believe that we should not accept diverticulosis as a cause of massive hemorrhage until all other causes have been ruled out.[1]

Time does not permit a discussion of the possible etiologic factors in diverticulosis except to conclude that in the colon the pouches are so-called "false" diverticula, meaning that they consist only of the mucosal and serosal layers of the bowel. Appearing late in life, they apparently represent inherent weaknesses of the muscular wall which have given way under the stress of constipation and increased intracolonic pressure. This weakness usually occurs along the mesenteric border of the bowel where the vessels perforate the layers of the bowel wall; hence the diverticulum is usually in close approximation to the vessels which in many instances are rather large, especially the veins. This anatomic arrangement has been very clearly revealed by Noer,[13] who injected human colon specimens removed at autopsy to demonstrate the vascular supply to the diverticula. Assuming a localized inflammatory reaction to be set up in such a diverticulum, it is easy to visualize an ulceration of the mucosa and an erosion into one of these vessels with resultant hemorrhage. Considered in this light, it is not surprising that such a bleeding point is almost impossible to find at the time of surgery, or even at postmortem examination with the bowel laid wide open. Usually the resected specimen has failed to show anything except multiple diverticula, and the pathologist is unable to determine which one, if any, was the source of the bleeding.

During the past several years a few isolated case reports have appeared in the literature describing patients who have been treated surgically for exsanguinating hemorrhage from diverticular disease. Young and Howarth[14] treated a fifty-three year old man with colectomy, removing the entire colon down to the lower sigmoid along with 21 inches of the terminal ileum, and performing primary ileosigmoidostomy. The patient died from coronary thrombosis. Welch, Allen and Donaldson[4] report five cases and advocate a three-stage resection as the safest procedure. In one case, following primary resection of the sigmoid, the patient continued to bleed and a second operation was necessary, at which time total colectomy was done. Cate[15] reports the case of a forty year old Negro woman in whom exploration was performed, the cecum opened and then closed because no bleeding point was found. She continued to bleed and eighteen hours later she was reoperated upon and total colectomy performed. It was impossible to tell from the specimen where the bleeding originated. Hoar and Bernhard[3] report four operated cases, with a mortality of 75 per cent. Their first case was a sixty-two year old man in whom a Mikulicz resection of the mid-sigmoid was carried out. The patient stopped bleeding following this procedure, but died from cardiac deterioration. Their second case, a sixty-nine year old man, underwent right transverse colostomy. This patient died from bronchopneumonia. The third case was a sixty-three year old man who was treated by Mikulicz resection of the sigmoid. The bleeding stopped but the patient died from bronchopneumonia. The fourth case was a seventy-two year old woman who entered the hospital with massive bleeding. The bleeding ceased spontaneously and she was then operated upon as an elective procedure. She was treated by primary resection of the sigmoid and supplementary cecostomy. This patient lived. All of these patients were over sixty; all had cardiovascular disease and hypertension. Hickey[16] reports a sixty-five year old man with exsanguinating rectal hemorrhage who was found to have diverticulitis of the sigmoid with perforation, abscess and fistula eroding into the left inferior epigastric artery. A Mikulicz procedure was done, followed in four weeks by resection and primary anastomosis. This patient recovered.

As can be seen from these reports, there has been very little uniformity as to the procedures employed. Furthermore, the mortality rate leaves much to be desired.

It is the purpose of this report to add to the literature three more cases of massive hemorrhage from the lower bowel, two of them treated surgically, in which the cause of bleeding was thought to be diverticulosis. It is unusual that all three of these patients were in the hospital and under treatment at the same time.

CASE REPORTS

CASE 1. J. B., a seventy-nine year old white man, was admitted to the hospital on January 29, 1955. He stated that four days previously he had become constipated and had noted

bright blood on straining at stool. He thought this was probably due to hemorrhoids and paid very little attention to it at the time. Two days later, however, he had a massive hemorrhage of dark liquid blood which made him weak and dizzy and he consulted his local doctor who hospitalized him. He was given a 1,000 cc. blood transfusion but the bleeding continued and he was transferred to our care. This patient had had cholecystectomy and prostatectomy in our hospital four years prior to this, and a review of his record showed that he had a barium study of his colon at that time which had showed rather extensive diverticulosis. There was reluctance to accept this as the cause of his present bleeding, however, and proctoscopic examination was attempted. This was not too satisfactory, due to the continuous steady bleeding into the end of the proctoscope, but it was believed that the rectum could be ruled out as the source of bleeding. In addition to his advanced age this patient had a rather severe cardiac condition, presenting some degree of decompensation. He gave a long history of bronchial asthma for which he habitually administered adrenalin® to himself several times a day. During the first twenty-four hours after admission he was given an additional 2,000 cc. of blood, with the hope that the bleeding would cease spontaneously. It became obvious, however, that he was losing blood faster than it could be replaced, and he was therefore taken to surgery. Laparotomy, performed through a right rectus incision, revealed that the colon, as well as the terminal ileum, was completely filled with blood. Extensive diverticulosis was present, but careful examination of the entire colon failed to reveal any evidence of carcinoma or polyps. The diverticulosis was most marked in the rectosigmoid area and extended in a gradually decreasing degree around to the hepatic flexure. There was no induration at any point to suggest an area of diverticulitis, and it was impossible to tell where the bleeding vessel was located. A small opening was made in the rectosigmoid area but no information could be obtained as to whether the source of the bleeding was proximal or distal to this point. A similar procedure was carried out in the right colon but here again the blood flowed freely from both proximal and distal limbs; therefore, both of these openings were closed. A decision was then made to take a chance on the rectosigmoid as the most likely site of the bleeding and to perform colostomy proximal to this point. A loop of the right transverse colon was brought out over a glass rod and the incision was closed around it. The patient was given 2,000 cc. of blood during and immediately following surgery and his asthma was controlled by large doses of benadryl® and cortisone. The colostomy was not opened primarily but Wangensteen suction was established to combat distention. During the next forty-eight hours he continued to pass dark red blood per rectum which was interpreted as old blood since there was no appreciable drop in his red blood count or hemoglobin. It was impossible, however, to rule out the existence of some persistent oozing, so it was decided to try topical medication to the distal colon. A mixture was concocted consisting of ½ ounce of powdered gelfoam,® 1,000 units of topical thrombin and 0.5 gm. of neomycin dissolved in 50 cc. of water. This medication was injected into the distal colon every two hours through a small catheter which was fixed with purse-string sutures into the distal limb of the unopened colostomy loop. Under this regimen the bleeding definitely stopped. Consideration was even given to the idea of dropping the unopened loop of colon back into the abdomen, but it was decided that such a procedure would probably be inviting a recurrence of the bleeding. The colostomy was therefore opened widely on the sixth postoperative day for complete diversion of the fecal stream. The remainder of the postoperative course was essentially uneventful. Two weeks following surgery a barium enema study was made which confirmed the operative diagnosis of very extensive diverticulosis. The patient was discharged on February 18, 1955, with his colostomy functioning well.

He was readmitted to the hospital one month later, again with slight cardiac failure and considerable asthma. The colostomy had functioned well and there had been no further bleeding. On the basis of his x-ray studies he was advised to have the sigmoid and descending colon resected prior to the closure of his colostomy. He refused to accept this advice and insisted on simple closure of the colostomy, stating that he was perfectly willing to accept the risk of further complications. Accordingly, his colostomy was closed on March 23, 1955. His postoperative course was uneventful and

he was discharged on April 2nd. A communication from this patient on September 30, 1955, stated that there had been no further bleeding.

CASE II. W. B. H., a seventy-four year old white woman, was admitted to the hospital on February 12, 1955, with a two-day history of constipation for which she had taken several doses of rather strong laxatives. On the morning of admission she had passed a great deal of red liquid blood, had become dizzy and fainted in the bathroom. Shortly after admission a proctoscopic examination was carried out, again with negative findings except for rather profuse bleeding coming down from higher than the instrument could reach. Again in this case there was a possible lead as to the cause of the bleeding inasmuch as three years before an x-ray of the colon at the office had shown extensive diverticulosis. However, this patient's problem was complicated by the fact that she had polycythemia vera and had been treated for the past ten years for this disease with frequent phlebotomies; in fact, this procedure had been performed only about a week prior to illness. There was also a history of a bleeding tendency. On one occasion she had been admitted to the hospital for persistent bleeding following a tooth extraction, and several transfusions had been required. She gave a history of bruising easily and on one occasion a large hematoma of the leg had developed following a relatively minor contusion. Studies of the blood picture, however, failed to show any deviation from normal regarding the bleeding or clotting time, prothrombin time or platelet count. This patient was bleeding rectally to an alarming degree and showed evidence of shock. During the first forty-eight hours in the hospital she was given 3,500 cc. of blood with no evidence of any cessation in the bleeding. Once again it became apparent that she was losing blood faster than it could be replaced. Consequently, on February 14th she was taken to surgery and the abdomen was opened through a left paramedian incision. As in Case 1, the entire colon and terminal ileum were found to be filled with blood, and careful examination of the colon failed to reveal any disorder except diverticulosis. As usual, the sigmoid colon showed the most extensive involvement, and this portion of the bowel was opened for inspection. Again it was impossible to tell whether the bleeding was coming from above or below the level of this opening, and the colotomy was of no help in determining the site of the bleeding. Therefore, transverse colostomy was again decided upon and a loop of transverse colon was brought out slightly to the left of the midline. Having had the experience of the first case, a catheter was immediately fixed with purse-string sutures into the distal limb of the colostomy loop. Soon after the patient returned to her room, instillations of the gel-foam-thrombin-neomycin mixture were begun at hourly intervals through this catheter. She continued to pass old blood per rectum for several days, but her hemoglobin and red blood count remained fairly stable and by the fourth postoperative day it was obvious that the bleeding had stopped. Again the question arose as to the advisability of dropping the unopened colostomy loop back into the abdomen, and again it was decided that such a procedure would be too hazardous. Consequently, on the sixth postoperative day the colostomy was opened widely for complete diversion of the fecal stream. The patient's further postoperative course was uneventful. There was no further bleeding and she was discharged on March 8, 1955, with her colostomy functioning well.

She was readmitted to the hospital on April 8, 1955, and a barium study again confirmed the diagnosis of extensive diverticulosis, particularly in the rectosigmoid and descending colon. Resection was recommended and the bowel was prepared. On April 11th resection of the left colon was carried out from just proximal to the colostomy to the rectosigmoid junction with primary end-to-end anastomosis. Her postoperative course was uneventful until about the seventh postoperative day when she exhibited extreme weakness, lassitude and mental confusion. The following day she was completely disoriented and a blood count showed a leukocytosis of 62,000. There was no elevation of pulse or temperature, the abdomen remained soft and non-tender, with good peristalsis, and bowel movements were normal except that the stools were somewhat liquid. She presented a most puzzling clinical picture which was thought most likely to represent an adrenal exhaustion. Massive doses of cortisone were given but the extreme weakness and mental confusion continued. She began to show signs of renal failure, passed into a coma and died on the thirteenth postoperative day.

Autopsy revealed that a coronary thrombosis was the immediate cause of death. The peritoneal cavity was clean and the anastomosis was well healed. The pathologist believed that the patient's generalized deterioration was best explained on the basis of morbid physiologic changes.

Case III. L. T., a seventy-one year old white woman, was admitted to the hospital on February 15, 1955, with a history of passing massive black tarry stools for two days prior to admission. Previous bowel habits had been good and there was nothing in her history to suggest any previous trouble in the intestinal tract. On admission to the hospital the red blood count was 2,220,000 with a hemoglobin of 6.7 gm. or 43 per cent. This patient was not actively bleeding and the situation was therefore not as urgent as in the other two cases. X-ray studies of the upper gastrointestinal tract were obtained first and were completely negative for any pathologic disorder. A barium enema was given which showed extensive diverticulosis involving the entire colon, most marked in the region of the hepatic flexure. She was given four blood transfusions, and after the second transfusion her stools were negative for blood. She was kept under observation for a few days and finally discharged on February 23rd with an erythrocyte count of over 4,000,000 and a hemoglobin of 80 per cent. A subsequent report from this patient on September 27, 1955, stated that no further bleeding had occurred.

COMMENTS

As a result of the experience gained from these three cases, and after reviewing the rather meager literature on the subject, it appeared that there were a number of controversial aspects and unanswered questions regarding the management of such cases.

The first question that naturally arises when one is confronted with a case of profuse hemorrhage from the lower bowel is, "Will the bleeding stop spontaneously?" Certainly the statistics would indicate that a large percentage of them will; Case III is an example of one that did. However, Cases I and II attest to the fact that some will not. It would seem that we should be guided here by some policy similar to that which we have adopted for massive bleeding from the upper gastrointestinal tract. Certainly, if there is no indication that the bleeding is slackening after four to six transfusions, there is no use in procrastinating further and laparotomy would appear to be indicated.

The second question centers around what should be done at the time of surgery. Certainly the first objective should be to make a definite diagnosis, if possible, as to the source of the bleeding. In both of the operative cases reported we were fortunate in having previous x-rays of the colon which had shown extensive diverticulosis. However, since these studies had been made several years previously there was still a possibility that some disorder other than diverticulosis was responsible for the hemorrhage. Consequently, the first step carried out at the time of surgery should be a thorough exploration of the entire colon to rule out such lesions as carcinoma, ulceration or polyps. In each of the operated cases (Cases I and II) the findings were practically identical—the entire colon was filled with dark blood, some of which had flowed in a retrograde manner into the terminal ileum. The colon showed no lesions other than extensive diverticulosis, most marked in the rectosigmoid area but involving in a gradually decreasing manner the descending colon, transverse colon and even the ascending colon. In neither case was there any evidence of diverticulitis as determined by the absence of adhesions or pericolic inflammatory thickening. Although colotomy was performed in both patients, opening the rectosigmoid area in each and the cecum in one, this procedure was of no help in determining the site of the bleeding. Such a procedure is probably not indicated unless there is a particular segment which is especially suspicious of an area of diverticulitis. The idea of inserting a sterile proctoscope through the colotomy incisions also came to mind, and it is possible that additional information as to the site of the bleeding might be obtained by this maneuver. This was not done, however, since it was believed that the procedure would be time-consuming and not too rewarding.

Once the diagnosis of bleeding diverticulosis has been verified by exploration, two surgical procedures immediately may be considered; either blind resection of the most involved area, usually the rectosigmoid; or transverse diversion colostomy. It is probably true that blind resection of the rectosigmoid colon would

eliminate the source of the bleeding in a high percentage of cases; yet it is entirely possible that the bleeding vessel might be proximal to this point, in which case the bleeding would continue. Furthermore, the fact that these are usually poor risk patients, in whom the bowel is filled with blood and poorly prepared, would seem to make them definitely poor candidates for primary resection unless accompanied by complementary cecostomy. Faced with this problem in Cases I and II reported herein, it was thought wiser to perform the simpler and more rapid procedure of diversion colostomy.

A third possibility suggests itself as a result of experience obtained from these two aforementioned cases. This would consist of the simple insertion of a catheter into the proximal colon, probably the cecum, through which topical coagulants could be administered. In both cases this was done in a modified fashion, using the protruding but unopened loop of transverse colon. In each case the instillation of a mixture of powdered gelfoam, topical thrombin and neomycin was followed by a cessation of the bleeding. Although in each case the colostomy was subsequently opened, the bleeding had apparently ceased prior to the diversion of the fecal stream and it will never be definitely known whether or not it was actually necessary to open the colostomy. This procedure of catheter cecostomy and topical instillation of coagulants is mentioned only because it parallels to a certain extent the current use of orally-administered coagulants in gastric hemorrhage. Certainly, diversion colostomy would seem to offer more certainty that the bleeding will cease.

The third problem involved in the two cases reported herein was what to advise the patient after the bleeding had ceased. They were, of course, anxious to be relieved of their colostomies at the earliest possible moment. Should resection be considered mandatory in every case? These patients undoubtedly had had diverticulosis for many years; just because they became constipated and had an episode of bleeding is the recommendation of resection justifiable? What percentage of such patients would be expected to have further trouble after simple closure of their colostomies without resection? If closure of the colostomy is decided upon, how long should the interval be? These are questions which cannot be answered unequivocally until further experience has been accumulated.

CONCLUSIONS

1. Three cases have been reported of massive exsanguinating hemorrhage from the lower bowel, all of which can probably be considered a complication of diverticulosis.

2. This complication is probably not as rare as it would seem from the scarcity of reports in the surgical literature.

3. It is a complication which will probably be seen more and more frequently as our population ages and the number of elderly people with diverticulosis increases.

4. Although in a large percentage of such patients bleeding will cease spontaneously, there will be a few in whom bleeding will concontinue. These will result fatally due to exsanguination unless surgical intervention is carried out.

5. The avenues of treatment open to the surgeon have been discussed, but much more experience is necessary before the wisest course of management can be determined.

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Cole and co-workers believe it is more important than the average surgeon realizes to adopt a few preliminaries before resecting a loop of colon (or small bowel) to remove a malignant growth. If the loop of bowel to be removed is ligated with tape several inches above the tumor site and again several inches below it, contamination of healthy bowel by spread of cancer cells is prevented. In like manner, if all the arteries and veins going to the loop to be removed are also ligated prior to cutting bowel and mesentery, we help to prevent spread of cancer cells via these vessels. Cole believes that postoperative recurrences can be substantially reduced by this simple addition to our surgical technic. (*Richard A. Leonardo, M.D.*)

Evaluation of Methods for Preoperative Degerming of Skin

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IT has long been recognized by surgeons generally that actual sterilization of skin surfaces prior to operative procedures is probably rarely or never completely achieved.

Several different methods of studying the relative efficiency of so-called antiseptic methods and materials used for degerming of skin have been described.

The pioneer work of Price and Bonnett[1] in relation to the development of scientific methods for the quantitative estimation of the bacterial population of skin paved the way for the introduction of improvements in technic by Artz et al.,[2] Kraissl[3] and Murphy et al.[4] A striking characteristic of the results reported by all of these investigators has been the amazingly wide variation in the numbers of bacteria present on the skin of similar body areas of different individuals. Frequently the numbers of bacteria present on a given area of skin of a specific individual will show tremendous variations at different times. Price[5] also distinguished between the so-called "resident" bacterial population of the skin consisting of a few different types of organisms, and the "transient" population which is of almost unlimited variety.

Evans[6] has contributed a factual description of the so-called normal or average resident bacterial population of the skin and has pointed out the numerical preponderance of the anaerobic organisms over the aerobes. He has called attention to the fact that the nature and number of the glandular structures in a given area of skin may be of the greatest importance in determining the types and numbers of bacteria present in the skin and on its surface. He found that Propionibacterium acnes was predominant numerically in most individuals, being followed with Micrococcus epidermidis, and Micrococcus pyogenes var. albus. Large numbers of resident Micrococcus pyogenes var. aureus were not reported. Areas of skin which contain relatively high numbers of sebaceous glands such as the ear conchae gave much higher bacteria counts than did areas such as the palms and soles where sebaceous glands are lacking and sweat glands are numerous.

The purpose of our investigation was to attempt to place on a quantitative basis the actual fate of both resident and transient flora when subjected to various degerming preparations at the time of surgery. Included in our study was an evaluation of the anaerobes as well as the aerobes present. We took a series of three biopsy specimens per case in connection with each surgical procedure. Unselected cases in which patients were undergoing a variety of general surgical procedures were utilized. The first biopsy specimen was taken immediately before scrubbing of the operative site in the operating room, the second immediately after the scrub, and the third at the completion of the operation. The operative incisions were made so as to connect the round punch biopsy holes which were full-thickness of skin. On closing these wounds, the slight irregularity was never noticeable.

Each biopsy specimen was macerated in saline according to a technic to be discussed herein, and a series of dilutions of the suspension were made and plated in agar. Thus evaluation of the antiseptic in question was attained through a count of the number of bacteria in the first, second and third biopsy specimens.

The degerming agents tested were bar soap containing 2 per cent hexachlorophene (gamophen®), liquid soap containing 1 per cent hexachlorophene (synol®), 0.5 per cent acrizane® chloride tincture (50 per cent alcohol,

50 per cent water),[4] and tincture of thimerosal (merthiolate®) 0.1 per cent (used routinely as part of the preoperative preparation at the Fitkin Memorial Hospital).

METHODS

The method of studying the test materials was as follows:

Bar soap containing 2 per cent hexachlorophene: The operative site was scrubbed with this soap the night prior to operation and the scrubbed area was covered with a sterile towel held in place with adhesive tape. At the time of the operation a three-minute scrub was carried out after the first biopsy specimen was taken, excess soap being wiped but not rinsed off.

Tincture of thimerosal 0.1 per cent (merthiolate): The operative site was given a soap scrub the night prior to the operation, as heretofore, but using plain soap in place of hexachlorophene soap. The tincture was applied at the time of the operation after removal of the first biopsy specimen.

Liquid soap containing 1 per cent hexachlorophene: (synol): The operative site was scrubbed the night prior to the operation with this soap (or with the bar soap). At the time of the operation a three-minute scrub was used after the first biopsy specimen was taken.

Acridane derivative (acrizane chloride) 0.5 per cent tincture: The operative site was scrubbed with soap the night prior to the operation. The tincture was applied at the time of operation after removal of the first biopsy specimen.

Removal of the biopsy specimens was accomplished with a standard 4 mm. biopsy punch. As each biopsy specimen was taken, it was placed immediately in a sterile tube containing 4.5 ml. of a sterile neutralizing solution composed of sodium thioglycollate and 1 per cent bovine albumin pH 7.0. Sodium thioglycollate and albumin were used to neutralize the effects, respectively, of mercurials and hexachlorophene. In the case of the acridane derivative, the neutralizing agent used was 4.5 cc. of a 0.3 per cent solution of congo red in saline.

The samples were refrigerated until tested. Refrigeration was necessary because the physical distance separating the hospital and the laboratory made it impossible to perform bacteriologic testing immediately after the biopsy specimens were taken.

In order to determine the effects of this practice of refrigeration and to test the technics employed, three weighed ground meat samples were substituted for biopsy specimens and were tested in accordance with test procedures followed throughout this study. The meat samples were plated out both aerobically and anaerobically, the first receiving no treatment, the second after twenty-four hours of refrigeration in 4.5 ml. of neutralizing solution, and the third after forty-eight hours of refrigeration in neutralizing solution. The plate counts of these samples indicated that the drop observed in the bacterial count was negligible and well within experimental error. Therefore, refrigeration of the test samples for twenty-four hours or longer did not interfere with the count and it was considered acceptable to refrigerate until bacteriologic testing was possible.

TABLE 1

Rating	Biopsy 1 to Biopsy 2	Change from Biopsy 2 to Biopsy 3
1.....	Decrease	Decrease
2.....	Decrease	No change
	No change	Decrease
3.....	Decrease	Increase
	No change	No change
	Increase	Decrease
3.....	No change	Increase
	Increase	No change
3.....	Increase	Increase

Each biopsy specimen was removed from the collection tube with sterile forceps and placed in a 2 ounce sterile mortar containing 1 gm. sterile alundum, mesh No. 90. The ends of the forceps were washed over the mortar with ½ ml. of sterile distilled water. Comminution of the specimen was then accomplished by grinding with a pestle for three minutes; at the end of this time the pestle was rinsed carefully with 5 ml. sterile water to remove any material or solution clinging to it. The neutralizing solution from the collection tube was added to the mortar. The resulting suspension was mixed thoroughly for one minute with a sterile pipet, then pipetted back into the collection tube and drawn up and down in

TABLE II

HEXACHLOROPHENE BAR SOAP*

Patient	Type of Operation	Time Required for Operation (hr., min.)	Aerobic Count				Anaerobic Count			
			Biopsy 1	Biopsy 2	Biopsy 3	Rating	Biopsy 1	Biopsy 2	Biopsy 3	Rating
F	Colonic resection	1:30	10	6	10	3	0	0	0	3
G	Gastrectomy	2:47	455	75	3	1	40	0	0	2
H	Uterine suspension and ligation	1:01	10	7	7	2	0	0	10	3
I	Inguinal adenectomy	0:25	17	0	3	3	0	0	0	3
L	Cholecystectomy	0:44	37	36	0	1	0	0	0	3
M	Hysterectomy	1:15	20	6	13	3	0	0	0	3
O	Cholecystectomy	0:58	590	10	0	1	500	0	0	2
Q	Radical mastectomy	1:18	0	333	3	3	2,027,000	70	1,582,067	3
Y	Cholecystectomy	0:43	12	0	0	2	10	10	10	3
AA	Nephrectomy	1:35	16	3	5	3	108	0	0	2
EE	Cholecystectomy	0:49	75	52	15	1	60	90	10	3
JJ	Cholecystectomy	1:00	23	10	0	1	50	0	10	3
LL	Mastectomy	1:25	120	61	33	1	181,800	82,933	156,333	3
RR	Herniorrhaphy	0:54	20	76	80	3	426,533	213,000	557,066	3
VV	Uterine suspension	0:50	3	3	6	3	65	10	0	1
XX	Oophorectomy	0:39	63	3	3	2	20	61,625	208,000	3
YY	Hysterectomy	1:47	0	10	0	3	10	0	0	2
AAA	Uterine suspension	0:52	17	10	0	1	50	0	0	2
BBB	Cholecystectomy	0:52	3	0	0	2	50	0	0	2
CCC	Oophorectomy	....	17	6	6	2	20	30	40	3
DDD	Skin grafting	1:08	89	50	0	1	40	20	10	1
EEE	Herniorrhaphy	0:47	343	17	2,015	3	200	0	0	2
FFF	Appendectomy and oophorectomy	0:40	20	3	10	3	0	0	0	3
GGG	Mastectomy	2:00	15	15	20	3	55	10	0	1
HHH	Herniorrhaphy	0:46	8,945	2,233	30	1	151,933	46,790	105	1
III	Sympathectomy, right	1:20	127	20	0	1	50	20	0	1
JJJ	Hysterectomy and appendectomy	1:00	24	6	1,533	3	0	20	8,920	3
KKK	Herniorrhaphy	1:05	27,337	44	23,963	3	2,130	0	23,700	3
LLL	Herniorrhaphy	1:05	3,585	65,500	1,650	3	43,500	89,100	2,650	3
MMM	Unspecified	2:05	0	0	0	3	10	0	0	2
NNN	Herniorrhaphy	1:00	0	60	30	3	10	60	0	3
OOO	Cholecystectomy	1:15	395	250	6	1	395	100	50	1

* Rating: 1. Best action; indicates an immediate drop and leveling off or continuing drop of the counts.
2. Fair action; indicates some activity.
3. No action; indicates an increase in counts.

the pipet three times. This suspension, called the original dilution, was diluted serially $\frac{1}{10}$, $\frac{1}{100}$, $\frac{1}{1000}$ in 9 ml. volumes of sterile water. All of the aforementioned steps were performed in an area particularly designed and equipped to minimize the likelihood of airborne or other microbial contamination.

One milliliter of each dilution was plated out in triplicate for aerobic plate counts and singly for anaerobic counts. The plating culture medium consisted of infusion broth (dehydrated difco®) modified through the addition (per liter) of the following substances: bacto-peptone,® 10 gm.; bacto dextrose, 8 gm.; bacto yeast extract, 10 gm.; sodium thioglycollate, 1.0 gm.; bacto agar, 15 gm.; final pH 7.4.

All the plates were incubated at 34°C., allowing a seven-day period for aerobic plates and fourteen days for anaerobic plates. Anaerobic conditions were produced by using Brewer anaerobic jars. All counts were made on a Quebec colony counter. Plates containing 300 colonies or less were recorded by actual count, whereas those over 300 colonies were counted by segment estimation.

PRESENTATION OF DATA

In an attempt to achieve objectivity in the evaluation of the resultant data, each case was arbitrarily assigned a numeric rating according to the scheme in Table 1.

It will be readily apparent that in this method of rating the most favorable antibacterial activity is designated by the lowest rating (1) and the least antibacterial activity by the highest rating (5), with two intermediate ranges on each side (2 and 4) of an inactive neutral zone (3) of doubtful activity.

The individual case ratings in each of the four different degerming method groups were added and then their sums were divided by the number of cases in that particular group. The resulting quotients then may be used as

TABLE III
TINCTURE OF THIMEROSAL*

Patient	Type of Operation	Time Required for Operation (hr., min.)	Aerobic Count				Anaerobic Count			
			Biopsy 1	Biopsy 2	Biopsy 3	Rating	Biopsy 1	Biopsy 2	Biopsy 3	Rating
D	Hydrocele repair	0:42	38,000	10,143	90	1	34,900	6,930	10	1
E	Tubal ligation	0:26	225	0	0	2	10	0	0	2
J	Cholecystectomy	0:46	0	0	0	3	0	0	0	3
K	Herniorrhaphy	0:50	14,070	8,600	3,800	1	3,600	0	0	2
N	Hip pinning	1:43	13,510	7	235	3	2,125	0	0	2
P	Multiple venous ligations	0:50	500	8	140	3	90	0	10	3
R	Cholecystectomy	0:55	537	0	0	2	115	60	0	1
S	Hip pinning	2:05	1,357	100	345	3	445	0	480	3
T	Panhysterectomy	1:10	3	0	682	3	0	0	833	3
U	Laparotomy and hysterectomy	1:16	0	20	35	3	0	0	20	3
V	Herniorrhaphy	0:23	2,675	6	0	1	2,573	0	0	2
W	Hysterectomy	1:53	30	3	0	1	40	70	10	3
X	Femoral herniorrhaphy	0:35	200	0	20	3	0	0	0	3
Z	Tubal ligation	0:22	37	37	0	2	10	0	0	2
BB	Tubal ligation	0:25	3	0	0	2	0	0	0	3
CC	Cholecystectomy	0:55	3	13	13	3	0	55	20	3
DD	Gastrectomy	1:50	275	43	13	1	10	0	10	3
FF	Gastrectomy	3:58	405	0	1,348	3	20	0	472,166	3
GG	Renal cystectomy	1:25	28	17	6	1	10	0	0	2
HH	Cholecystectomy	2:34	46,613	2,214	6	1	23,150	1,173	265	1
II	Colonic resection	1:00	13	0	0	2	0	0	50	3
KK	Inguinal herniorrhaphy	0:54	40	0	45	3	70	0	60	3
MM	Lumbar sympathectomy	1:00	60	45	3	1	20	0	60	3
NN	Colonic resection	1:55	968	122	2,288	3	5,710	7,335	1,613	3
OO	Colonic resection	1:53	85	6	6	2	75	0	0	2
PP	Mammary cystectomy	0:30	260	30	0	1	1,773	0	20	3
QQ	Cholecystectomy	1:40	0	0	0	3	10	0	0	2
SS	Herniorrhaphy	0:55	513	710	30	3	0	505	0	3
TT	Appendectomy	0:35	0	10	65	3	0	0	0	3
UU	Abdominoperineal resection	1:50	10	6,545	3	3	10	8,246	0	3
WW	Hysterectomy, abdominal	0:57	295	3	0	1	.....	.....	.....	..
ZZ	Gastrectomy	2:30	10	0	10	3	0	0	0	3

* For explanation of rating see footnote to Table II.

convenient and simple bases for comparing the four different methods of skin degerming as applied to aerobic and also to anaerobic organisms. The bacterial colony counts and efficiency ratings of the individual cases in each of the four different degerming technics are presented in Tables II to V. It is emphasized that these data are in no sense to be accepted as absolute counts but are to be interpreted only on a purely relative basis.

INTERPRETATION OF DATA

It will be noted that on numerous occasions "0" counts were reported. The significance of this is not known, but such data are strongly believed to be artefacts and to hold no significance with respect either to the presence or absence of bacteria on the skin or the activity of the respective degerming method.

In the opinion of Dr. W. S. Connor, by whom the data were examined, the tabulated ratings do not indicate any statistically valid difference in the relative effectiveness of the different methods of degerming under study. Dr. Connor commented as follows:

"For both aerobic and anaerobic counts, tests were made of the hypothesis that the antiseptics do not differ. The test used is an approximate Chi-square test, which is described in an article by W. G. Cochran, 'Some Methods for Strengthening the Common X^2 Tests,' *Biometrics*, Vol. 10, No. 4 (1954), pp. 417–451. The technique is given in section 7.1, pp. 439–440.

"Assuming that the hypothesis is true, for the aerobic counts the probability is .80 of obtaining averages at least as heterogeneous as the observed averages, and for the anaerobic counts the probability is .59. Because both probabilities are large, there is no reason to doubt the hypothesis for either type of organism."

COMMENTS

It has long seemed obvious that there is no such thing as true skin asepsis—a clinical

TABLE IV

LIQUID HEXACHLOROPHENE SOAP 1%*

Patient	Type of Operation	Time Required for Operation (hr., min.)	Aerobic Count				Anaerobic Count			
			Biopsy 1	Biopsy 2	Biopsy 3	Rating	Biopsy 1	Biopsy 2	Biopsy 3	Rating
A	Mammary biopsy	0:22	165	30	0	1	0	0	0	3
B	Herniorrhaphy	1:03	1,016	896	0	1	980	715	0	1
C	Herniorrhaphy	....	3,786	1,340	6	1	31,095	20,010	10	1
D	Laparotomy	1:00	60	0	3	3	30	30	30	3
E	Herniorrhaphy	1:35	29,150	440	0	1	34,086	440	155	1
F	Cholecystectomy	1:32	3	60	100	3	80	55	10	1
G	Hysterectomy	1:50	536	6	0	1	555	10	10	2
H	Hysterectomy	1:40	32	20	0	1	10	100	150	3
I	Excision of lipoma	0:57	6	3	3	2	20	60	10	3
J	Laparotomy	1:18	17	0	0	2	60	0	0	2
K	Herniorrhaphy	1:25	0	0	0	3	0	100	20	3
L	Uterine suspension	0:48	6	10	0	3	10	0	0	2
M	Hysterectomy	0:35	17	0	0	2	10	0	0	2
N	Cholecystectomy	0:20	0	0	0	3	0	0	0	3
O	Excision of mammary cyst	0:20	3	0	0	2	65	50	0	1
P	Excision of cyst of back	0:22	3	0	0	2	10	50	0	3
Q	Hysterectomy	1:30	3	3	0	2	0	0	0	3
R	Herniorrhaphy	0:35	6	0	0	2	0	0	100	3
S	Hysterectomy	1:20	30	0	0	2	95	65	60	1
T	Hysterectomy	0:20	0	3	103	3	100	0	37,466	3
U	Resection of jejunum	1:40	565	55	13	1	105	55	10	1
V	Gastrectomy	2:15	3	100	105	3	100	0	50	3
W	Cholecystectomy	0:45	0	0	0	3	10	0	0	2
X	Hysterectomy	1:30	28	3	28	3	100	0	50	3
Y	Gastrectomy	2:15	6	36	0	3	0	0	0	3
Z	Abdominal and perineal	1:10	0	0	0	3	0	0	0	3
AA	Hysterectomy	1:33	20	3	0	1	10	0	10	3
BB	Herniorrhaphy	1:10	43	31	0	1	10	0	0	2
CC	Herniorrhaphy	0:41	70	3	3	2	10	10	0	2
EE	Herniorrhaphy	1:10	30	40	130	3	40	20	10	1
FF	Gastrectomy	3:25	70	3	6	3	400	21,250	55	3
GG	Colonic resection	1:40	2,206	3	3	2	1,680	320	0	1
HH	Herniorrhaphy	0:47	0	460	0	3	0	285	100	3

* For explanation of rating see footnote to Table II.

truism that would seem to be well supported by the data obtained in this study. On the basis of clinical and empiric observations alone, one gains the distinct impression, which is not incompatible with statistical analysis, that broadly speaking there is little difference in the bacteria-suppressing activity of the three antiseptic agents tested (hexachlorophene, merthiolate and acrizane chloride). One inclines more strongly toward the belief that the effective factor in preparing the skin for surgical incision is the mechanical removal of gross dirt and germs by thorough cleansing with soap and water. This may well be true in spite of the fact that there were fewer excessively high counts in the initial biopsy specimen when a bar soap containing hexachlorophene had been used the night prior to operation than when plain bar soap was used.

An incidental finding of interest was the high initial counts which were almost uniformly obtained in inguinal herniotomy procedures. Hernia operations are classically regarded as "clean" cases, and the incidence of wound infection in such cases is generally accepted as a test of the surgeon's skill. However, the evidence gathered in these studies indicates that the pubic and inguinal regions, due to the high bacterial counts, are potentially dangerous sources of infection. For that reason, more attention might well be devoted to preparing this site for operative procedures and perhaps a more tolerant view adopted toward those who occasionally encounter a low grade infection in this region. The high counts observed in hernia operations are clearly shown in the foregoing tables if the patients are grouped as to type of operation rather than antiseptic employed.

There appeared to be a close correlation between the incidence of infection in wounds, particularly in the pubic area, and a high bacterial count of the biopsy specimens. This was especially true if the anaerobic count was high,

TABLE V
ACRIDANE DERIVATIVE*

Patient	Type of Operation	Time Required for Operation (hr., min.)	Aerobic Count				Anaerobic Count			
			Biopsy 1	Biopsy 2	Biopsy 3	Rating	Biopsy 1	Biopsy 2	Biopsy 3	Rating
3D	Herniorrhaphy	0:53	4,538	20	0	1	4,803	0	0	2
3E	Appendectomy	0:35	3	3	3	3	100	40	0	1
3F	Gastrectomy	....	45	20	6	1	105	60	120	3
3G	Gastrectomy	3:05	3	3	0	2	0	115	415	3
3H	Mastectomy	0:18	330	0	0	2	55	105	0	3
3I	Bilateral herniorrhaphy	1:00	1,066	4,736	23	3	1,320	5,676	170	3
3J	Gastrectomy	0:23	90	0	0	2	130	60	637,000	3
3K	Oophorectomy	....	107	0	115	3	145	10	4,300,000	3
3N	Herniorrhaphy	0:57	18	0	0	2	65	21,550	100	3
3O	Tubal ligation	0:34	1,480	0	0	2	2,245	10	0	1
3P	Cholecystectomy	1:50	30	0	0	2	10	277,500	10	3
3Q	Hysterectomy and appendectomy	1:03	0	0	145	3	20	20	0	2
3R	Colonic resection	1:24	47	0	0	2	130	10	179,500	3
3S	Laparotomy	1:10	0	0	0	3	10	0	0	2
3T	Herniorrhaphy	1:20	2,256	0	0	2	2,145	0	0	2
3U	Unspecified	2:32	360	3	0	1	395	90	0	1
3V	Unspecified	....	0	0	0	3	105	0	65	3
3X	Cholecystectomy and gastrostomy	1:15	3	0	0	2	215	295	170	3
3Y	Gastrectomy	1:30	73	3	0	1	100	0	0	2
3Z	Gastrectomy	2:10	35	0	0	2	75	10	20	3
4A	Gastrectomy	3:08	65	0	0	2	105	0	0	2
4B	Hysterectomy	....	0	0	0	3	0	0	0	3
4C	Herniorrhaphy	....	17,310,000	1,810,000	40	1	20,160,000	2,090,000	40	1
4D	Gastrectomy	....	50	0	0	2	300	200	55	1
4E	Cholecystectomy	0:32	0	0	0	3	10	20	10	3

* For explanation of rating see footnote to Table II.

which it usually was found to be, probably because of the density of sebaceous glands in this area.

The fact that the acridane derivative appeared to give the best results on aerobic bacteria and the hexachlorophene liquid soap the best on the anaerobes, suggested that a combination (scrubbing the night before operation with the soap and using the acridane derivative immediately preoperatively) might improve the results, but further studies failed to show any improvement over the use of either preparation singly.

SUMMARY

1. A useful *in vivo* technic has been described for evaluating preparations intended for degerming the skin. The effect upon both anaerobes and aerobes can be measured.

2. Differences in the effectiveness of four studied methods of degerming were not found to be statistically significant.

3. The suggestion is made that there may be a need for greater care in the preparation of skin prior to operations in which sebaceous glandular components predominate, and that the factor of mechanical cleansing itself is an important adjunct to the suppressive action of so-called skin antiseptics.

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Cerebral Vascular Insufficiency Following Minor Surgery in the Aged

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ONE of the wonders of the human body is its ability to adjust to a wide range of varying conditions in its environment and in its own physiologic processes. That this ability to adapt lessens with advancing age is obvious. One need only recall common changes in older people such as loss of elasticity of the skin, decreased accommodation of the lens of the eye for close vision, increased discomfort at the extremes of environmental temperatures or the frequency of fractures of the femur from trauma which would be minor in a younger person. The brain shares, no less than the rest of the body, in this general loss of adaptability with advancing years.

Many conditions must be met to permit continued normal functioning of brain tissue. These can be divided into two main groups: (1) chemical-nutritional and (2) hydrodynamic. Among the former, glucose and oxygen are the best understood clinically although numerous other substances, both known and unknown, must be available to brain tissue at all times and in the proper amounts. The hydrodynamic factors necessary for adequate functions of brain cells are numerous. There must be vessels of sufficient caliber; a pump adequate to move the blood through these vessels under enough pressure to overcome peripheral vascular resistance and at enough speed to prevent stagnation; a sufficient volume of circulating fluid to maintain pressure in the system; and a proper ratio of hemoglobin to plasma so as to avoid stagnation from hemoconcentration on the one hand, and anemic anoxia from hemodilution on the other.

The failure of any single part of this nutritional-mechanical complex results in damage to brain cells. Whether such damage is reversible or permanent depends on the degree of deficiency and the length of time it persists. With the exception of hypoglycemia, the breaking of any link in this chain results eventually in cerebral hypoxia.

The term acute cerebral vascular insufficiency was evolved by Corday, Rothenburg and Putnam.[1] Their report is concerned with the results of the failure of a single part of the aforementioned mechanism, namely, the maintenance of an adequate arterial pressure. They have shown, clinically and experimentally, that sudden arterial hypotension can result in transient or permanent cerebral damage.

It is the purpose of this paper to emphasize the frequency of the syndrome of acute cerebral vascular insufficiency in a common clinical situation—minor surgery during the later decades of life. The vascular insult in this case is not due to a massive failure of any single component of the nutritional-mechanical complex, but rather to the cumulative effect of lesser failures of many components. Cerebral vascular disturbances after minor surgical procedures are not uncommon. The importance of the subject lies not in its rarity but in several other factors. First, there is a very human tendency on the part of the physician to regard a stroke after a minor operation as a coincidence, regrettable but without any cause and effect relationship. This leads to a rather sterile attitude toward prevention and treatment. Second, in many instances postoperative cerebral vascular complications are preventable either by avoiding certain elective operative procedures or by taking added precautions if surgery is performed. Third, there are obvious medicolegal implications, particularly if the surgery is carried out to repair the effects of trauma. In the literature dealing with the subject of postoperative vascular complications one finds a great deal about peripheral thrombophlebitis, coronary thrombosis and pulmonary embolism; very little is said about disturbances of the cerebral circulation and even less about the physiologic processes involved and their proper management.

The following case is an example of the type of problem under consideration:

A fifty-nine year old rural policeman was shot in the right shoulder in the line of duty at 1:30 A.M. on June 14, 1953. He was admitted immediately to the local hospital in his western Wisconsin community. Past and family histories were negative. Clinical and x-ray examination indicated that the bullet had entered the upper dorsal aspect of the shoulder, traveled medially through the belly of the trapezius muscle and lodged in the soft tissues just superior to the vertebral end of the right first rib. There was no fracture and no other injury. The patient's general condition was good and blood loss was minimal. His blood pressure was 158/90. Nine hours later the bullet was removed. Anesthesia consisted of intravenous sodium pentothal® (1,000 mg.) and curare (75 units) plus inhalation of ether-oxygen. Duration of anesthesia was 70 minutes. Morphine (gr. ¼) and scopolamine (gr. 1/150) were given preoperatively. Postoperatively he received demerol® (50 mg.) and nembutal (gr. 1½). He was returned to bed with the shoulder immobilized by pillows. That evening, some ten hours later, he complained of headache and seemed confused for a short while. He slept well and seemed alert the next day, but toward evening again complained of headache and, in addition, transient numbness of his right arm. The following morning, forty-eight hours after surgery, he was depressed and irritable. In the next few hours he became confused and had some weakness of the right arm. Within twelve hours complete right hemiplegia and aphasia developed without loss of consciousness.

He was first seen by me on July 21, 1953, about five weeks later, at which time examination revealed complete right hemiparalysis, weakness of the lower right portion of the face, expressive aphasia and a slightly dilated right pupil. He was disoriented and displayed marked emotional lability. There was no evidence of any injury to the peripheral nerves of the right arm or shoulder. He was transferred to the Miller Hospital, St. Paul, for further study and because his disturbed mental condition made his care difficult in a small general hospital.

X-ray of the skull showed a slight shift of the pineal calcification to the right. A left carotid angiogram was normal except for failure of the anterior cerebral artery to fill with contrast medium. Pneumoencephalogram showed the ventricles to be at the upper limit of normal and not distorted; there was slight enlargement of the subarachnoid space especially over the left frontoparietal area. The spinal fluid contained eight cells, 42 mg. per cent of protein, a negative Wassermann reaction and a normal colloidal gold curve.

The patient gradually improved and was discharged home about three months after his injury. His strength and speech became better but he continued to be very disturbed and noisy, especially at night, and had some paranoid delusions.

Whether this patient suffered a cerebral thrombosis following surgery in June, 1953, or whether a cerebral infarct without thrombosis developed is clinically immaterial. Whether or not a spontaneous cerebral vascular accident would have developed ten days or ten years later is equally immaterial. The important point is the continuity in time between surgery and the onset of the first symptoms of cerebral vascular insufficiency a few hours later. Contributing to this catastrophe are the basic factors of the patient's age and associated arteriosclerosis. As the necessary "last straws" are the elements of anesthesia, immobilization in bed, analgesics, and decreased respiratory excursion due to curare and to pain in the injured shoulder.

Fortunately, not all cases result in such disabling residuals. Particularly after surgery for the removal of cataract one may note marked confusion and restlessness, often with transient hemiparesthesias, coming on during one of the first few postoperative nights. In such circumstances, the patient in his confused state will often treat his condition very effectively by arising from his bed and forcibly removing the mask from his eyes. The ophthalmologist is wise who, in such a case, accepts the gamble of a separation of the corneal incision rather than forcibly restraining the patient in bed either mechanically or with heavy sedation.

A second case will illustrate this point:

A seventy-two year old woman was admitted to the Miller Hospital on January 24, 1949, for the extraction of a senile cataract of the right eye. History was negative except for Bell's palsy on the left which had occurred years before. The general examination preoperatively was otherwise negative. Blood pressure was 170/90. The night before surgery she received seconal® (gr. 3) and slept well but seemed

unusually apprehensive. On January 25, 1949, the cataract was removed uneventfully under local anesthesia. She was put to bed with the eyes masked; sandbags were used to immobilize the head. On the following morning she was confused, restless and disoriented. This cleared up but recurred the evening of January 27th, and she remained in a state of delirium. She was given empirin compound® with codeine (gr. ½) sodium luminal® (gr. 1) two to three times a day. She became worse and when seen by me on January 31st was noisy, restless and disturbing to the entire hospital floor. Neurologic examination was negative except for slight weakness of the mouth on the left. The palpable arteries were sclerotic and moderate choroidal arteriosclerosis was seen on examination of the left ocular fundus. Mentally she was confused, disoriented and noisy. Her mood alternated between euphoria and terror. She was immediately ambulated and the mask removed. All sedation was stopped. Her mental symptoms rapidly improved except for occasional brief spells of mild confusion on February 1st. She was discharged from the hospital two days later.

The capability of the brain to resist anoxia and to recover from its effects seem to vary inversely with age. A sixteen month old infant survived and eventually improved after ten minutes of anoxia due to laryngospasm and cardiac standstill.[4] In a forty year old man, reported by Douglas,[2] five minutes of complete anoxia led to death in ten days. In the later decades increasingly severe infarction can be expected from more modest degrees of cerebral hypoxia. Cerebral infarction has been described after mercurial diuresis,[6,8] after the routine testing of carotid sinus sensitivity in an eighty-three year old patient,[10] and after the evacuation under great strain of a large fecal mass.[7] I have seen permanent hemiplegia and aphasia develop in a seventy-three year old woman after the application (for intracranial aneurysm) of a Selverstone clamp to the carotid artery and its closure by only one-sixth for two hours. The latter case, developing after only slight narrowing of the caliber of the carotid artery, is better appreciated if one recalls Poiseuille's law[1] which states that in a system of rigid tubes carrying fluid under a constant pressure the volume of flow per unit time is proportional to the fourth power of the diameter of the tube. This law of physics dramatically emphasizes the danger of cerebral vascular insufficiency from arteriosclerotic narrowing of a cerebral artery: reducing the caliber of the artery to one-half will lead to a reduction in flow through it to one-sixteenth. Studies by Fazekas et al.,[3] as well as by Scheinberg and his co-workers,[9] have shown that a marked decrease in cerebral blood flow and increase in cerebral vascular resistance occurs in individuals over fifty; these changes are more pronounced in patients with cerebral vascular disease than in controls of the same age. In both groups the inhalation of 5 to 10 per cent carbon dioxide reversed these changes toward normal. Against this background of decreased vascular lumen and increased vascular tone, relatively minimal changes in physiologic conditions can result in enough failure of the cerebral circulation to produce infarction. Age and arteriosclerosis have loaded the gun; only a slight pressure is needed on the trigger. The frequency with which cerebral thrombosis occurs when a patient awakens in the morning is a common example; the slight hypotension and slowing of cerebral circulation during sleep are enough to permit clotting in a vessel prepared by arteriosclerosis. Cases of cerebral thrombosis in cardiac decompensation fit the same pattern. In view of the effects of these minimal stresses, it is not surprising that the conditions surrounding minor surgery are often more than adequate to produce vascular disturbances of a serious nature.

Permanent residual cerebral deficit following a vascular accident indicates some degree of tissue destruction or infarction. Many of these are due to occlusion of arteries by thrombi, emboli or arteriosclerotic plaques. However, in a significant number no mechanical obstruction of the vessel can be found. This was true in sixty of 100 autopsy studies in cases of cerebral infarction reported by Hicks and Warren.[5] In such cases one must postulate slowing of the cerebral circulation, a critical drop in blood pressure, a decrease in the degree of oxygenation of the blood, or any combination of these. Acute cerebral vascular insufficiency must be regarded as a clinical syndrome rather than as a single pathologic entity. There are many factors which contribute to the total picture in the cases which follow minor surgery. Most of these can be determined preoperatively. They all apparently act by producing anoxia of the stagnant anemic or anoxic types. They

should be recognized as danger signs; the greater their number and the more intensely they are present in a given patient, the greater the risk of postoperative infarction. The risk of anoxia of the stagnant variety can be estimated by an evaluation of: (1) the age of the patient; (2) the degree of arterial hypertension, as a measure of peripheral vascular resistance; (3) the duration and depth of anesthesia; (4) immobilization of the patient; and (5) the amount of analgesics and sedatives—analgesics, especially morphine, also tend to create an anoxic type of anoxia, as does (6) anything which decreases respiratory excursion, be it the pain of an injury to the chest with splinting of the chest wall or pre-existing pulmonary disease; and finally (7) one must evaluate the amount of blood loss in cases of trauma as producing anoxia of the anemic type. The two categories of minor surgery in which cerebral vascular insufficiency is most likely are cataract surgery (because of the advanced age of the average patient and the need of immobilization) and traumatic surgery (because of the added factor of blood loss).

In considering the prevention and treatment of these conditions we are faced with a very limited area in which to work. In our present state of knowledge the two major factors of arteriosclerosis and the decreased adaptability of older patients to physiologic stresses cannot be attacked clinically. Accordingly, even effective and successful treatment means in some cases only a postponement of the time when infarction will occur.

Treatment should be based on a realistic attempt to minimize the degree and duration of anoxia of all types, and falls into six categories. Foremost is a careful weighing of the need for surgery against the total amount of conditions just outlined as contributing to postoperative anoxia. Broadly speaking, age is a relative contraindication to elective surgery. It has become a truism to observe that ageing is not in itself a disease but does predispose to illness. The benefits to the patient resulting from surgery must be balanced against an estimate of the risk of producing hemiplegia. Second in importance is the institution of prompt treatment at the first sign of cerebral vascular insufficiency. Impending infarction may often take the form of mild transient confusion, irritability or headache during one of the first few nights postoperatively, with disappearance of these symptoms during the following day. It is at this stage that the urge to temporize must be firmly overcome and prompt measures taken before the process becomes irreversible. The remaining procedures are aimed at the direct prevention of cerebral anoxia or its correction if it has already occurred. This includes the use of local or spinal anesthesia if possible and safe and, if not, the least amount of general anesthesia for the shortest period of time consistent with good surgical practice; the correction of blood loss and decreased circulating volume; early ambulation of the patient in any manner from frequent turning in bed to having him up and walking; the use of 5 to 10 per cent carbon dioxide in oxygen intermittently during the first postoperative days; and finally, the use of a minimum amount of analgesia and sedation. In the last regard it should be noted that in our efforts to relieve pain, we often do the patient an injustice; pain may be physiologically beneficial in that it keeps the patient somewhat restless and lessens the dangers of immobilization.

In the light of these considerations the subsequent history of the first case is of interest. On September 20, 1954, one year after the development of a cerebral infarct following the surgical removal of a bullet from the shoulder, this sixty year old policeman was readmitted to the Miller Hospital because of an infected pilonidal sinus. Neurologic reexamination showed that he was able to walk with a right spastic gait with the aid of an ankle brace, the right arm remained paralyzed and spastic, and his speech was intelligible but still dysphasic. His mental condition was the same as it had been at the time of his discharge a year before. Because of the pain of the infected sinus and the added difficulties it made in his care, surgery was decided upon, and on September 27, 1954, the sinus was excised. Preoperatively the patient received sodium seconal® (gr. 1½) and atropine (gr. 1/150). Low spinal anesthesia was used. Blood loss was minimal. Postoperatively he was given empirin compound with codeine (gr. ½) and 5 per cent carbon dioxide and oxygen inhalations for three minutes each hour until the following morning. He was up and around the day after surgery. He tolerated the procedure well, his wound healed by granulation and he was discharged home on November 8, 1954.

Thus far his neurologic and mental status remains as it was prior to surgery in September, 1954.

SUMMARY

An attempt has been made to emphasize the importance of a neurologic complication of minor surgery. In the later decades of life the decreased adaptability and the presence of arteriosclerosis may be well tolerated until the patient is faced with the need of adjusting to a group of factors, each tending to contribute some degree of transient cerebral anoxia. The effect of these various stresses is cumulative and their sum total is capable of resulting in acute cerebral vascular insufficiency. Based on the physiologic changes involved, certain measures are suggested which would seem to lessen the risk of anoxic damage to the brain. As new drugs and technics steadily increase the human life span, physicians have a vital responsibility to try to keep the added years as free as possible of disabling neurologic symptoms. State hospitals filled with elderly patients who are psychotic due to cerebral vascular damage cannot be considered a tribute to medical progress. Until the problem of preventing the development of arteriosclerosis and hypertension is solved, no practical clinical means of postponing their effects even temporarily should be overlooked.

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Groin Dissection

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THE place of groin dissection in the surgery of cancer is subject to wide variation in the conception of many surgeons. Historically, in 1912 Basset described the groin dissection which is the basis for the procedure which is presently popular. Modifications have been made by various men in later years, particularly Taussig in 1935. Basset described what is now termed superficial groin dissection and Taussig clarified it further as radical groin dissection.

LYMPH NODES IN THE GROIN

Anatomy. The anatomic distribution of the lymph nodes to be removed in groin dissection is along the course of the major vessels of the region. A complete study of the distribution was described most recently by Daseler et al.[2] The superficial lymph nodes are distributed in the deep subcutaneous layer of the femoral triangle in relation to the principal superficial veins of the region, the greater saphenous, the superficial circumflex iliac, the superficial epigastric and the superficial external pudendal veins. The deep lymph nodes of the inguinal region are situated along the femoral vein and in the canal. Cloquet's or Rosenmueller's node constantly lies at the entrance to the canal. The external iliac nodes are grouped on the anterior and medial aspects of both the vein and artery. The principal hypogastric node lies at the bifurcation of the hypogastric and iliac arteries. Other hypogastric nodes are found adjacent to the hypogastric vein. Important lymph nodes are present along the obturator vessels and nerve, in the obtutator foramen and along the uterine vein.

Rationale for Surgery. On the assumption that cancer cells principally pass from the primary lesion to the regional lymph nodes by embolic phenomena, it seems logical to remove those lymph nodes when the primary lesions can be controlled. Groin dissections are designed to remove the first echelon nodes of primary carcinomas draining to them.

Types of Groin Dissections. Superficial or simple groin dissection removes the lymph nodes in the femoral triangle. Radical groin dissection proceeds from the point at which the simple operation ends and consists of removal of the external iliac, hypogastric, obturator and uterine nodes, accomplishing what is often referred to as "iliac lymphadenectomy."

INDICATIONS FOR GROIN DISSECTION

In general, radical dissection is preferred over simple dissection. The simple procedure may be indicated in the aged, as a palliative procedure in selected cases of advanced disease, when it is necessary to perform bilateral dissection in conjunction with block excision of a primary lesion, when previous pelvic surgery makes iliac lymphadenectomy impractical, or in other instances to be outlined later. Iliac lymphadenectomy alone may be a very useful operation in cases of cancer of the bladder, uterus or cervix when the primary lesion has been controlled and there is reason to believe malignant invasion of the regional lymph nodes has occurred. First, the six postulates of Pack and Rekers[5] for a successful curative groin dissection should be listed: (1) The primary cancer, wherever located, should be controlled or controllable and should be treated first. (2) There should be no clinical evidences of metastasis through the blood stream. (3) The lymph stream must be centralward without evidence of blockage and retrograde extension. (4) It should be technically possible to excise all lymph nodes involved or suspected of becoming involved in the immediate neighborhood. (5) There must be some possibility of interruption of the lymphatic spread of cancer by an excision of these nodes. (6) Evidence should be present that the cancer has drained only to the regional groups of nodes to be attacked in the groin dissection.

Skin Cancer of the Lower Extremities. Epidermoid carcinoma of the skin of the lower

extremities with clinically involved nodes in the groin requires radical groin dissection on the involved side. Radical dissection in the absence of clinically involved nodes is debatable. Pack and Rekers reported that in 24 per cent of cases with epidermoid carcinoma of the extremities and without palpable regional lymph nodes, nodal metastasis subsequently developed while the patients were under observation. In this instance they never perform prophylactic dissection, but wait for nodal involvement. The work of Taylor and Nathanson[7] showed that the incidence of metastasis increased in direct ratio to the size of the primary lesion, in higher grades of malignancy and with longer duration before treatment was instituted. It would seem that prophylactic dissection might be reserved for the cases in these latter groups. Primary lesions over 3 cm. in diameter, those present for more than one year, and the more anaplastic lesions would fit best in these groups.

Melanoma. Groin dissection is always indicated in cases of melanoma of the lower extremities, if resection is possible. Frieden[3] found evidence of metastasis in 66 per cent of the nodes removed in thirty-eight cases. Of forty-five cases treated by Pack and Rekers, lymph nodes containing cancer were present in thirty-nine. Whenever possible, the removal of the primary lesion and groin dissection should be performed as block excision and dissection in continuity. However, when the primary lesion is far removed from the groin, it is best to delay groin dissection for several weeks if there are no nodes clinically palpable. In this way it is believed that the regional nodes may act as a filter basin. If the nodes are enlarged, they should be removed as soon as possible after control of the primary lesion.

Skin Malignancies of the Lower Abdomen. The ilioinguinal glands drain the lower abdominal wall from the level of the umbilicus. Groin dissections are indicated in this area under the same conditions as the lower extremities.

Cancer of the Vulva and Clitoris. The lymphatic drainage is bilateral and necessitates bilateral groin dissections. The principle of block excision and dissection in continuity can be carried out by vulvectomy and superficial bilateral groin dissections if there is no clinical evidence of metastasis. This may be performed as a single procedure in the patient considered a good risk. If there is evidence of metastasis, the radical procedure should be performed in stages. Taylor and Nathanson reported that 43 per cent of thirty-eight cases showed metastasis to the groin. The same principles are involved in the management of carcinoma of the penis.

Carcinoma of the Anus and Perineum. The lymphatic drainage from this area is primarily to the superficial groin nodes. The deeper nodes are involved from the superficial nodes rather than directly from the anus. Another modifying factor is that abdominal perineal resection for the control of the primary lesion makes iliac lymphadenectomy technically a difficult and unsatisfactory procedure. In general, bilateral superficial groin dissection, in stages, is the preferred method of handling groin nodes. Whether or not prophylactic dissection is justified depends upon the degree of malignancy of the primary lesion, the patient's general condition and the likelihood of the patient to co-operate with careful follow-up.

Miscellaneous. This group includes sarcomas of the extremities and other malignancies of the areas draining to the groin. When the primary lesion is controllable and only regional lymphatic metastasis is evident, groin dissection is indicated.

Contraindications. Groin dissection is contraindicated in the following instances: (1) distal metastasis; (2) failure to control the primary lesion; (3) fixation of malignancy to structures which cannot be removed, such as the femoral artery; (4) extension of disease beyond the limits of resectability; and (5) poor surgical risks who might not tolerate the operation.

TECHNIC

Radical groin dissection is performed in the following manner. The patient is placed in the supine position with the hip abducted and externally rotated. The incision is started from a point at the level of and about 2 inches lateral to the umbilicus. (Fig. 1.) It extends to the mid-groin, crossing the inguinal crease over the femoral artery, and ends above the apex of the femoral triangle of the thigh. The skin flaps are beveled outward as in mastectomy. The widest point of the block excision is at Poupart's ligament. The fat is dissected from the external oblique aponeurosis from the upper end of the incision down to Poupart's ligament. Below Poupart's ligament the incision is car-

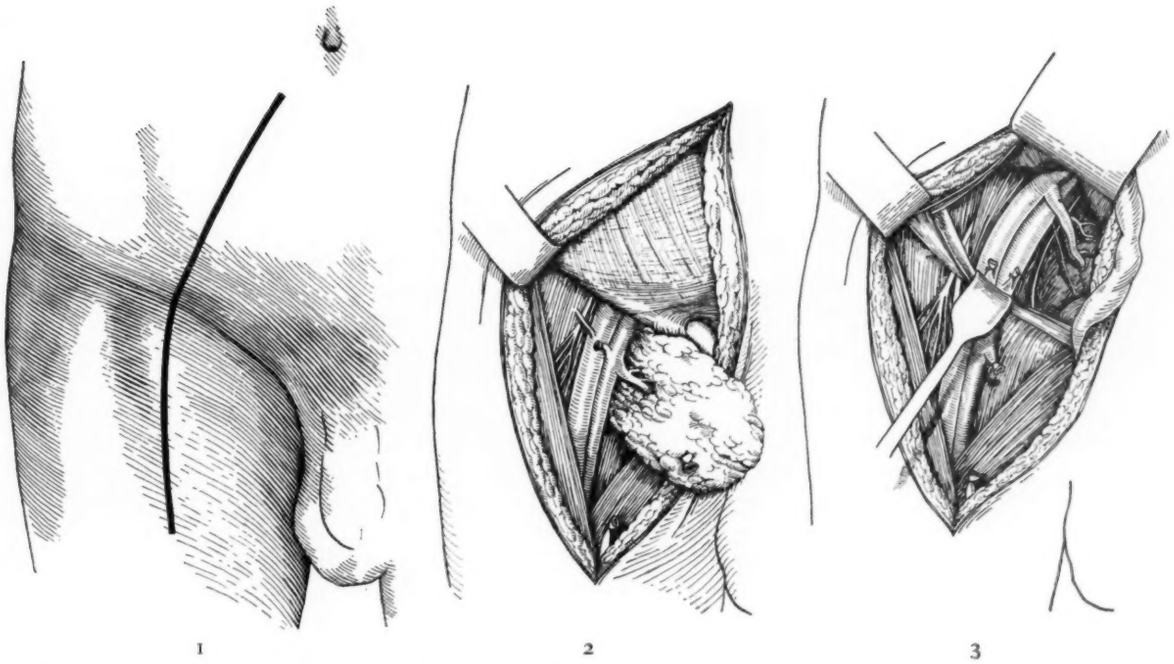

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FIG. 1. Skin incision parallels iliac and femoral vessels.

FIG. 2. Completion of superficial phase of dissection.

FIG. 3. Specimen has been removed. Iliac vessels are exposed. Obturator nerve is seen in depth of surgical field.

ried down to and includes the fascia overlying the sartorius muscle laterally, the adductor muscle medially and the junction of these muscles inferiorally. The external saphenous vein is ligated and divided at the level of the apex of the femoral triangle. The sheath of the femoral vein is incised in Hunter's canal and the vessels cleaned by sharp dissection to the saphenofemoral junction. The entire femoral triangle is dissected free of its fat and lymph nodes *en bloc* to Poupart's ligament. The saphenous vein is ligated and divided at the saphenofemoral junction. (Fig. 2.) The surgical specimen is removed, completing the superficial phase of groin dissection. Continuing with the deep portion of radical dissection, the external oblique aponeurosis is incised in the direction of its fibers from the external inguinal ring to a point above the internal inguinal ring. The undersurface of this aponeurosis is widely dissected from the underlying internal oblique muscle. In the female, the round ligament is severed for exposure.

In the male, the spermatic cord is mobilized and retracted. The internal oblique muscle and transversalis fascia are freed from Poupart's ligament in the area of the internal inguinal ring. The inferior epigastric vessels are divided and ligated. The internal oblique muscle and transversalis fascia are freed from the peritoneum by blunt dissection and then incised from the external inguinal ring to the upper end of the skin incision which lies at the level of the umbilicus and about 2 inches lateral to it. The peritoneum is next mobilized medially by blunt dissection, exposing the iliac vessels. The peritoneum carries the ureter with it. The dissection begins at the common iliac bifurcation superiorly and over the psoas muscle laterally. It is carried down to Poupart's ligament, removing the fat and lymph nodes *en bloc* in the field of dissection. Medially, the dissection is carried to the uterine vein and bladder in the female. A constant plexus of large vessels is found on the bladder in this region and should be carefully avoided. Serious bleeding will be encountered if this plexus is disturbed. The obturator nerve is carefully cleaned and the nodes in the obturator fossa are removed. The femoral canal is dissected free of its contents and the surgical specimen is removed. (Fig. 3.)

Repair is carried out by closure of the abdominal wall in layers with interrupted

cotton sutures. The transversalis fascia is reapproximated to Poupart's ligament. The wound ligament is repaired. The technic of Baranofsky[1] has been found very helpful in obliterating the dead space of the femoral triangle which otherwise accumulates serum and interferes with wound healing. This technic utilizes the sartorius muscle by severing it at its origin. The muscle is mobilized and placed in the triangle. The origin of the muscle is reapproximated to the central portion of Poupart's ligament. The skin is closed with interrupted silk sutures. A compression dressing is placed over the groin and the entire extremity is wrapped in elastic bandages. The wound is drained with a Penrose drain through a stab wound.

COMPLICATIONS

The most frequent complications are serum collections in the wound and edema of the extremity. Proper drainage of the wound and obliteration of dead space by the sartorius muscle transplant have been the most effective measures for control of the serum collections. Edema of the extremity in the dependent position is present in all cases immediately following surgery. However, after a period of six to eight months the lymphatic and venous drainage re-establishes a new network which eliminates edema. Patients who have had some degree of wound infection are most likely to have chronic edema of the extremity. The scarring secondary to infection interferes with proper subsequent drainage. It is advisable to warn the patient of the possibility of chronic enlargement and intermittent swelling of the extremity.

Postoperative mortality is rare following groin dissection. The complications of any major surgical procedure such as pulmonary atelectasis, pneumonia, cardiac failure and sepsis are occasionally seen following groin dissection. The tendency of the wound edges to slough is greater than in most major operations, but seldom is a serious complication. It is not difficult to devitalize the skin flaps which results in sloughing of the skin.

RESULTS

The author's cases have not been followed up long enough to draw significant conclusions of long-range results. Taussig reported thirteen cases of cancer of the vulva with metastasis to the groin. Sixty-five per cent of this group were cured by vulvectomy and groin dissection. Taylor and Nathanson[7] reported 29 per cent two-year cures in fifty-two groin dissections for squamous cell carcinoma of the skin of the lower extremities. As might be expected, their cure rate dropped to 17.5 per cent in positive dissections for malignant melanomas for five years. The results vary considerably with the type of lesion and with various authors. There are wide variations in technic, ranging from the type of incision for exposure to the groups of lymph nodes removed.

The following four case histories illustrate a variety of malignancies in which groin dissection has been useful.

CASE REPORTS

CASE I. The patient, a seventy-one year old white man, was seen with the complaint of a mass in the anus and rectal bleeding of six months' duration. Examination revealed a proliferative mass in the anus, measuring 2.5 cm. in the greatest diameter. A biopsy specimen was taken and was reported as squamous cell carcinoma. The lymph nodes in the groin were palpable bilaterally. A Miles abdominoperineal resection was performed. Five weeks later right radical groin dissection was performed. Dissection in hypogastric and obturator regions was unsatisfactory due to previous pelvic surgery. The pathologic report revealed inflammatory changes in lymph nodes and no evidence of metastatic malignant disease. Three months later left superficial groin dissection was accomplished. The pathologic report showed only inflammatory changes.

CASE II. The patient, a sixty-four year old white woman, was seen with the complaint of pruritus vulva. Examination revealed leukoplakia of the entire labia minora with a 3 mm. ulcer of the left labium minus. A biopsy specimen of this area was reported as squamous cell carcinoma. No nodes were palpated in the groin. Two weeks after the biopsy specimen was taken, radical vulvectomy and simultaneous bilateral superficial groin dissection was carried out. The pathologic report revealed no malignant changes in the nodes in the groin.

CASE III. The patient, a thirty-four year old white woman, was seen with the complaint of pain and swelling of the right upper leg.

Examination revealed a mass of nodes in the groin, the largest of which measured 2.5 cm. in the greatest diameter. Slight diffuse enlargement of the upper leg was present. Marked tenderness to palpation was noted. X-rays studies revealed an osteolytic lesion of the proximal tibia. An upper thigh amputation was performed in combination with radical groin dissection. All lymph nodes were found to be positive for metastatic disease. The pathologist reported Ewing's sarcoma. Since the patient is now free of disease five years later and skeletal x-ray surveys have failed to demonstrate other areas of bony involvement, the pathologic classification of the sarcoma as Ewing's may be inaccurate. However, it unquestionably was a bone sarcoma with lymphatic metastasis. Groin dissection greatly contributed to the favorable outcome of this case.

CASE IV. The patient, a forty-five year old white woman, was seen without complaint. She had been treated one year previously for stage I squamous cell carcinoma of the cervix by 1,800 roentgen units to four pelvic portals. This had been followed with radium implantation needle radiation of 4,500 mg. hours. Examination revealed a scarred cervix, apparently free of disease. A biopsy specimen was taken and showed no abnormalities. In the right adnexa and adjacent to the distal right lateral wall of the vagina, several small nodules were palpated. Right iliac lymphadenectomy was performed. Three lymph nodes were reported to contain metastatic disease.

SUMMARY

The types of groin dissection have been discussed, including indications, contraindications, technic and illustrative cases.

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Residual Volume in Surgical Patients with Cardiac Disease

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THE new trend in surgery is toward physiology. Anatomy as learned by the surgeons of yesteryear must be supplemented with a kinetic or *in vivo* visualization of structure. It is not enough to know the surgical anatomy of the mitral valve and interventricular wall. The effect of the bulging septum and the contracting mitral ring on the blood flow through the valve in systole must also be fully appreciated. One must be able to evaluate the usual regurgitant jet felt along the posteromedial angle of the mitral commissure. The remarkable change in residual air volume in heart disease should be fully appreciated. We make pulmonary function studies on all our patients with cardiac disease in their routine preoperative work-up. Catheterizations are carried out in conjunction with these if indicated.

This article is concerned primarily with the residual volume studies in our subjects. Since we have developed an accurate method of predicting lung compartments (within 0.70 per cent), we can determine small deviations from normal which are of real significance.[1]

METHOD

Residual air determinations are carried out by our own modification of the Cournand open circuit method.[2] The vital capacity is determined from routine spirometry and from these the total lung volume is known. The normal lung volume for the patient in question is now calculated by our own method.

The patient's true normal residual volume is calculated by subtracting the patient's actual vital capacity from the calculated total volume. The difference between the calculated and experimentally determined residual volume is, of course, due to disease.

RESULTS

Table I summarizes the findings in the subjects to be discussed. In mitral stenosis without excessive cardiac enlargement there is an increase in the residual air from an average normal of around 1,500 to approximately 4,000 ml., accompanied with an increase in the pulmonary capillary pressure (P.C.).

Patient R. G., with pure mitral stenosis, is an example. His residual volume was 3,728 ml. (normal 1,300 ml.) and vital capacity 900 ml. (normal 4,070 ml.). His oxygen removal at rest was 26 ml. per L. (normal 40 ml. per L.) and on exercise 27 ml. per L. (normal 60 ml. per L.). This is the usual finding in mitral stenosis. (Table II.)

Patient F. F., who came to our surgical service for reoperation for mitral stenosis, also had an increase in his residual volume (normal 1,700 ml.) to 3,808 ml., with a vital capacity of 1,672 ml. The vital capacity after his second operation was reduced to 1,310 ml., due mainly to severance of the left phrenic nerve at operation; the residual volume was increased to 4,063 ml. The mitral valve could not be refractured although an attempt was made through the left inferior pulmonary vein.

It is of surgical interest that the patency of the vein was not interfered with; the oxygen consumption increased by 200 ml. per minute with exercise before and after the operation.

Oxygen removal at rest remained approximately the same pre- and postoperatively (25 and 28 ml. per L.). (Table II.) The oxygen removal on exercise increased postoperatively to 37 from 28 ml. per L. This was due to the paralyzed left diaphragm. Had thrombosis developed of the inferior left pulmonary vein, there would have been a total loss of perfusion to the left lower lobe with, it is true, some ventilation of this lobe albeit an impaired one, and the oxygen removal would have decreased moderately at rest and greatly on exercise.

Subsequently clinical signs and symptoms of pulmonary edema developed, during which time we restudied the patient's residual volume. It now was decreased to 2,099 ml., with a vital capacity of 1,400 ml. and a total lung capacity of 3,499 ml. The heart remained moderately en-

TABLE I

Initials, Age and Sex of Patients	Diagnosis	Vital Capacity (ml.)	Residual Volume (ml.)	Total Capacity (ml.)
R. G., 46, M.	Mitral stenosis	900	3,728	5,400
F. F., 47, M.	Mitral stenosis			
	Preoperative study	1,672	3,808	5,480
	First postoperative study	1,310	4,063	5,373
	Second postoperative study	1,400	2,099	3,499
M. M., 50, F.	Tricuspid insufficiency	912	437	1,349
C. J., 27, F.	Mitral stenosis	2,056	506	2,562
M. A., 56, M.	Aortic stenosis	3,201	2,963	6,164
R. E., 38, F.	Mitral stenosis	2,436	1,193	3,629
	Second study	2.900	888	3,788
C. E., 54, F.	Mitral stenosis	1,400	1,856	3,256
	Second study	1,758	1,451	3,209
R. T., 36, M.	Mitral stenosis	3,840	1,705	5,545
W. P., 32, M.	Mitral insufficiency	3,000	2,305	5,305

larged. This illustrates the fact that pulmonary edema decreased the residual volume and the total lung capacity by 1,964 ml. and 1,874 ml., respectively.

In the patients with cardiac disease who have extremely enlarged hearts (hearts 2 L. in size) the residual air is displaced volume for volume by the heart enlargement, and the usual increase in residual volume due to an increased P.C. pressure is decreased by this amount. In other words the increased residual volume would be still larger if the heart were of relatively normal size by an amount equal to the cardiac enlargement.

Patient M. M., with mixed valvular disease, illustrates this point. She had a heart 2 L. in size. The residual air was 437 ml. and the vital capacity 912 ml. The residual capacity one would expect for this patient's amount of disease if her heart were not grossly dilated from decompensation would be 3,000 ml. Her normal residual volume would be 1,100 ml.

Patient C. J. is another example of a patient with a greatly dilated heart depressing the residual volume by actual displacement of residual air; his residual volume was 506 ml. (predicted 1,100 ml.) and his vital capacity 2,056 ml. (predicted 2,140 ml.).

TABLE II

Patient	Oxygen Consumption (ml./min.)		Ventilation (L./min.)		Oxygen Removal (ml./min.)	
	Rest	Exercise	Rest	Exercise	Rest	Exercise
R. G.	224	317	8.3	11.6	26	27
F. F.						
Preoperatively	185	388	7.5	13.8	25	28
Postoperatively	205	391	7.12	10.6	28	37
C. E.						
Preoperatively	217	...	8.9	....	24	..
Postoperatively	388	...	11.1	....	35	..

The condition of patient M. A. is an example of pure aortic stenosis with a normal-sized heart and post-stenotic dilatation; his residual volume was 2,963 ml., whereas it should have been 1,800 ml.; his vital capacity was 3,201 ml., about 1,000 ml. below his predicted normal.

The improvement obtained by preoperative treatment in mitral stenosis is well shown by patient R. E. Her residual volume and vital capacity on November 25, 1954, were 1,193 and 2,436 ml., respectively. She was given mercuhydrin® and digitalis since there was fibrillation, and fourteen days later her residual

volume decreased by 305 ml. and her vital capacity increased by 464 ml. The total lung volume increased by 159 ml.

A decrease in residual volume (toward normal) is indicative of an improvement if the vital capacity increases concomitantly. If the vital capacity did not increase, the decrease in residual volume would indicate either an increase in cardiac dilation or the start of pulmonary edema.

The case of patient C. E. further illustrates the change in pulmonary function with treatment (effective use of diuretics). Her vital capacity, residual volume and total capacity were 1,400, 1,856 and 3,256 ml., respectively. Three days later they were 1,758, 1,451 and 3,209 ml., respectively. Her oxygen removal also improved from 24 to 35 ml. per L. at rest, which can be interpreted as due to a decrease in the depth in the extracellular fluid through which oxygen must diffuse to reach the alveolar capillary from the alveolus.

The case of patient R. T. illustrates the fact that the patient with mitral disease in excellent compensation without symptoms has a relatively normal residual volume. This patient recently completed three years in the Army on active duty (battle training, etc.). His residual volume and vital capacity were 1,705 and 3,840 ml., respectively. There was no change in his vital capacity after a bronchodilator was used; we believe this fact rules out "occult pulmonary edema" in our non-asthmatic patients with cardiac disease.

In patient W. P. the residual volume increased to 2,305 ml. from a normal of 1,500 ml., due mainly to nitral insufficiency and some stenosis with beginning right and left ventricular failure. His vital capacity was decreased by 1,000 to 3,000 ml. Insufficiency results in a relatively smaller increase in residual volume than stenosis because of the periodic or wave-like increment in pulmonary capillary pressure as seen in the C waves of the P.C. tracing in contradistinction to the sustained increase which accompanies stenosis.

COMMENTS

The residual volume depends upon the size of the alveoli as well as upon their ability to empty. The flexibility or elasticity of the alveolar capillary determines the degree to which the alveolus can contract on maximum expiration. Back pressure from mitral or aortic stenosis and/or insufficiency cause an increase in the pulmonary capillary pressure (P.C.) and in the pulmonary artery pressure (P.A.). This causes the capillaries to "straighten out," which in reality means to become more curved or more curvilinear. Spheres of irregular outline tend to become of more regular outline and therefore larger. To put it mathematically, of all isoperimetric figures that which contains the greatest area is a circle, and as a corollary it follows for spheres.[3]

The integral in its true mathematic connotation of spheres (or integral of the alveoli) is greater then as the capillary pressure becomes greater. In pulmonary edema the residual volume is decreased since air is actually displaced by transudate.

In occult pulmonary edema there is a small increase in vital capacity of the order of 200 to 300 ml. after the use of vaponefrin.

Great cardiac dilation as noted heretofore also decreases the residual volume; and as the dilation decreases, the residual volume paradoxically increases. After the dilation has subsided, the increased residual volume decreases again toward normal as the P.C. and P.A. pressure approach normal. As the residual volume decreases due to improvement, the vital capacity increases. There is a transformation of dead residual space to functioning vital space.

SUMMARY

The pulmonary function studies performed on our surgical patients with cardiac disease are discussed with special reference to the changes in residual volume. An increase of 200 to 300 per cent is found in severe valvular disease.

Pulmonary edema (occult and frank) decreases the residual capacity regardless of whether or not it has been increased.

The usefulness of residual volume determination in following up the improvement of a patient under therapy is demonstrated. A relatively normal residual volume is found in a well compensated patient. The residual volume can be used to assess the status of a patient with cardiac disease.

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Contraindications for Plasma As the First Fluid in Severe Shock after Burns

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Read before the Fourth Annual Meeting of the Pacific Northwest Society of Plastic and Reconstructive Surgery, Spokane, Washington, May 21, 1955.

IT is not the intention of this article to consider the subject of burns in detail but simply to discuss one point, namely, the inadvisability of giving plasma as the first fluid for severe shock after a burn. What is said does not apply to the giving of plasma at other times and under other conditions. The giving of plasma will be considered only as the primary fluid to be administered in severe shock after a burn. Reference is made to the precise time after the infliction of a serious burn when shock is severe.

When an individual is extensively burned, there is great loss of fluid from the circulation by two sources: (1) externally from the body, oozing; and (2) within the body, edema. When a tank with a hole in it is being filled, the quickest way to restore the fluid level is first to stop the leak. The same applies in the treatment of burns. The early application by cotton swabs of freshly made 5 per cent tannic acid solution followed with 10 per cent silver nitrate solution and drying[1–5] closes the leaking surface at once, comparable to the closing of a spigot. Loss of fluid is stopped immediately. Then when fluid is administered, it is not lost but tends to remain within the body; and smaller amounts are needed. Furthermore, these local applications change the surface, which but a moment before was irritant and wet, into a dry innocuous surface so that there is no longer a call for the dilution of the irritant which has now been fixed and rendered inert. Because there is early stoppage of the continuing necessity for more fluid, the edema recedes and it is necessary only that the already absorbed toxic and irritant substances be destroyed and eliminated by the body, and the circulating fluid with its metabolites already lost be restored. The edematous fluid will be reabsorbed promptly when the irritant is fixed and removed. Healing is then prompt and smooth.

Often by the time patients receive treatment they are already in deep shock. The giving of plasma to a patient who has a reasonable amount of circulating fluid in the blood stream is not deleterious; but when the dehydration reaches a critical point, glucose solution, physiologic saline solution or other aqueous solution should be given. If plasma is given to a patient at the critical period which the author has in mind, the plasma by osmosis may act to immobilize some intravascular fluid, leaving the blood cells, perhaps in a limited area, with insufficient fluid to allow for their free circulation. When this happens, sludging of the blood may take place. Should sludged blood obstruct a vessel in the brain, a permanent lesion may develop or even death may result. One can visualize that sloughing may follow when the sludging lodges in other tissues.

From the information at hand, it is impossible to state just where the critical concentration or dehydration point is, except to say that it must be severe. Plasma having a higher osmotic equilibrium draws to itself nearby fluid. If after the plasma is introduced and has absorbed its quota of extracellular fluid sufficient fluid remains in that vessel to allow circulation of the blood elements to continue, the plasma will do no harm and may do a great deal of good. However, sludging may occur with pathologic results when the critical point is at hand, even if a small amount of the fluid in which the blood cells are suspended is withdrawn from the circulation at one point by the plasma (so that insufficient fluid remains in that vessel and the blood cells "strike bottom" in moving about). This may take place far from the point of entrance of the plasma.

Let us consider sludging a little further.[6] Anatomically, the peripheral blood vessels are progressively narrowing, long cone-shaped arterioles and cylindric capillaries.[11] As the blood cells are normally propelled along, sometimes the vessel lumen is smaller than the blood cells, so that the cells are compressed and the

vessel dilates from the force behind. This resistance slows the rate of blood flow through these vessels. Thus the rate at which the oxygen and glucose can be carried to the endothelial walls of small blood vessels is reduced.[8] When trauma is present, anoxia of the endothelium permits blood fluid to pass out freely through the walls of the small blood vessels. This causes hemoconcentration of the passing blood at that point and edema of the surrounding tissues with reduction of the circulating blood volume, depending upon the extent of the injury. When the rate of flow is slow, and under certain conditions, the red blood cells agglutinate and tend to settle to the lower sides of the blood vessels. They then tend to accumulate into masses which may become thrombi. If these are sufficiently large, they may block small vessels and cause multiple minute emboli and/or multiple minute thrombi.

Some sludges consist mostly of small masses of blood cells with a scattering of larger masses. These later, if not too large and rigid, may cause multiple minute temporary embolization. The larger masses plug the arterioles they enter and then squeeze through slowly.[9] The elements may then separate again as they pass through the vessels. Under other conditions, larger or smaller masses of the cells float away in the fluid stream until they become stranded. Large masses may cause permanent plugging of vessels. In any event, there is a local decrease in the venous return to the heart; also, interference with the vasomotor system may follow.

The effect of sludging depends upon the physical characteristics of the sludge which is present, including the size and degree of internal rigidity of the mass and on the degree of stickiness of its outer surfaces. Thus there may be many degrees of severity and many different combinations depending upon different pathologic conditions which may be present. Pathologic sludge following severe burns may be a major factor in burn shock, burn toxemia and burn anoxia.[10] Degeneration of affected tissues then may follow.

One case in mind is that of a three year old girl who suffered a deep burn from fire which covered 60 per cent of her body surface. She was so dehydrated when first seen a few hours after the accident that the veins could not be entered with a needle and considerable time was necessary for the intern to cut down on a large vein and insert a cannula. During this time her hemoglobin was reported to be 121 per cent. A child of this age has about 90 per cent hemoglobin as a normal; therefore the 121 per cent based on the adult reading would actually be 134 per cent. However, in obtaining the specimen the technician did considerable squeezing and other manipulations were necessary, so it is reasonable to estimate that if only 10 per cent serum were added, the blood concentration actually was in the neighborhood of 150 per cent or perhaps more. Finally the cannula was in place and plasma started. During this time the weeping of the skin had been stopped, additional loss of fluid prevented and the further call for edema relieved, as the surface was now clean and dry.

Plasma is a thick, syrupy liquid, and in this case it was made to flow through the cannula with difficulty. Some hours thereafter a tic developed on the right side of the mouth which at intervals involved the right facial muscles about the eye, and the thumb of the right hand. Despite consultation with and the assistance of two brain surgeons, the condition progressed and the child died on the fifth day. Examination of the brain showed degeneration in the region of the posterior wall of the left sylvian fissure of a type that might well have been due to sludging of the blood with the resulting degeneration of surrounding brain tissue.

The portion of the brain posterior to the sylvian fissure was purplish red, flattened and contained considerable clotted blood. The involved area was rather sharply limited but the periphery gradually faded into the surrounding brain substance.

It has been the author's practice previously in treating burned patients to start with the intravenous administration of 5 per cent glucose in water and later to give physiologic saline solution; sludging has never occurred. A man with 54 per cent of his body surface burned had a hemoglobin of 165 per cent which promptly came down to 101 per cent. One woman had 150 per cent hemoglobin. One child had 42 per cent of the body burned and the hemoglobin was 170 per cent (28.90 Gm.). This child came 100 miles by automobile for attention without having received even one drop of fluid or any other treatment whatsoever. None of these patients received any plasma or blood; all responded promptly to aqueous solution of glucose followed with saline and all recovered.

The rationale of parenteral aqueous fluid administration is briefly as follows:[7] The glucose solution provides water to replace the necessary expenditures of water by the body, and the electrolyte solution replaces the fluids lost by dehydration. The uses of glucose and electrolyte solutions are entirely separate. The water in the glucose solution is used, while the water in the electrolyte solution is retained. This is so only when the obligatory expenditures of water are replaced by glucose solution. The necessity of glucose solution therefore has priority.[6]

Besides the water supplied, the giving of glucose solution has several physiologic benefits: it reduces the losses of body water and electrolytes that occur in the fasting state. The glucose itself conserves body fluids and protein. Also, fasting over twenty-four hours may produce acidosis to a marked degree and the antiketogenic effect of glucose is considerable. The interesting and important subject of intra- and extracellular fluids in burns cannot be discussed in further detail within the limits of this article.

The recent literature indicates that under the pressure dressing treatment or the exposure method, few patients are saved who have second and third degree burns of more than 40 per cent of their body surfaces. However, with tannic acid and silver nitrate solutions applied promptly in the absence of grease and oil, and followed with drying and the administration of glucose and saline solutions, patients with over 80 per cent of their skin burned have been saved.[5]

Following injury by heat there is an avidity of the tissues for fluid which is drawn from the blood circulating adjacent to the injured parts for dilution of the irritant and for other necessary purposes. Thus there is a lessening of the ability of these solutions to increase the blood volume until the urgent needs of the tissues about the burned area are fulfilled. However, as stated before, when the surface is dry after being rendered innocuous, this greatly increased demand for fluids is not present.

This call for fluids to dilute the irritant should be anticipated as the edema continues to increase for many hours when the irritating surface is not promptly rendered innocuous. It will be recalled that the secretion of urine in burned patients is dependent upon the presence of fluid which can otherwise be spared from the body economy, and urinary suppression occurs when this excess is not available. Experience with hundreds of burned patients reveals that urinary suppression and/or albuminuria are never present when tannic acid and silver nitrate solutions are promptly and properly applied and followed with drying, providing that grease or oil has not been applied nor has the patient had a temperature over 101°F.

Whether the hematocrit reading or the hemoglobin percentage is used, correct interpretation of the blood concentration is the important factor.

It is not to be understood that this article opposes the use of plasma under other conditions, as plasma may be valuable when the blood concentration is not at or near the critical point. The point the author wishes to bring out is that plasma and perhaps albumin, and maybe even blood, may precipitate a crisis if introduced into the circulation when loss of fluid is at this critical point.

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Use of Amniotic Membranes to Cover Surface Defects Due to Flame Burns

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SKIN defects of large areas following flame burns may cause immediate or delayed fatalities. Individual homeostasis is depleted by shock, infection and protein loss. In addition, there is failure of normal thermoregulation. Brown has stated that the improvement in the patient's general condition following a deep, large thermal burn is directly proportional to the amount of skin which is covered.[1]

Brown has also recently emphasized the use of postmortem homografts as biologic dressings for the denuded areas due to excessive burns.[2] As a supplement to local care of the trauma, amniotic membrane has been suggested as an emergency covering.[3] Douglas and others[4–6] have demonstrated in laboratory animals that

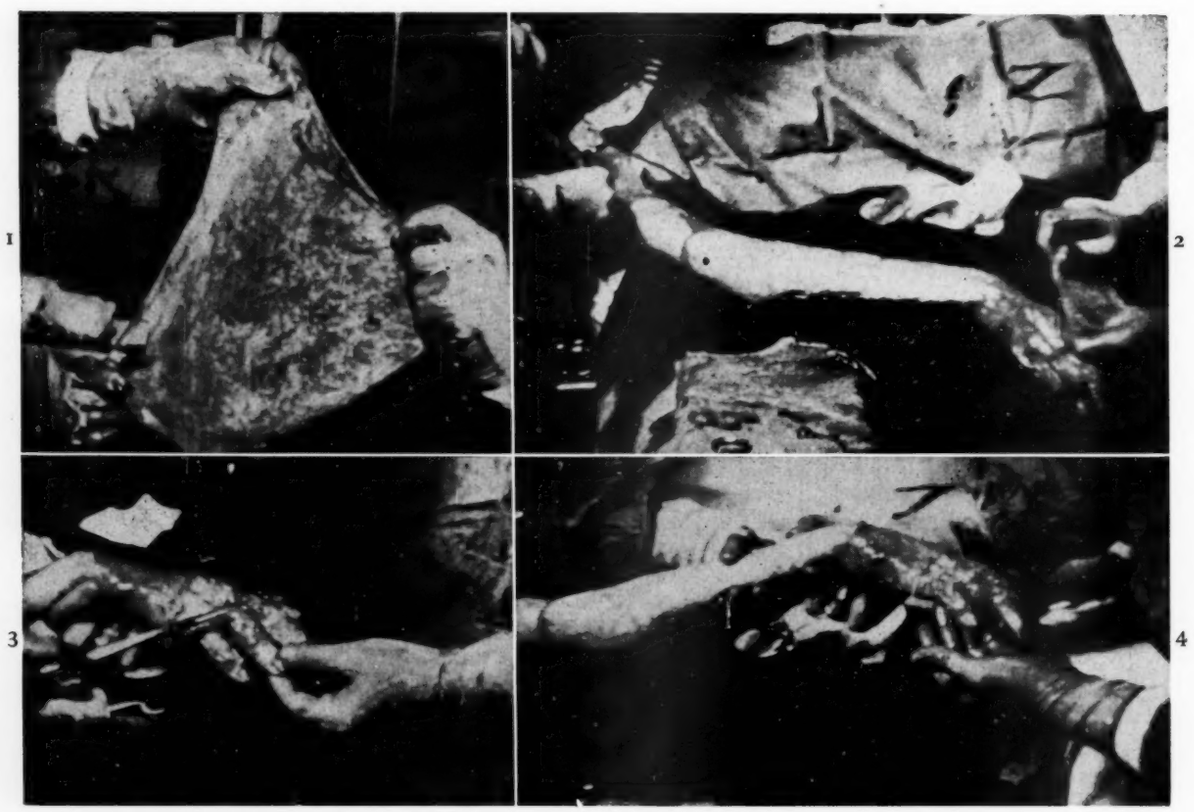

FIG. 1. Amniotic membranes ready for use after being washed in saline.

FIG. 2. Case 1. Right shoulder, elbow and forearm have had placental membrane applied by coaptation. Fine mesh gauze covers these areas. Graft is being applied to the dorsum of the hand.

FIG. 3. Same case. Prepared patterns of the membranes are sutured to the digits.

FIG. 4. Same case. Completed coverage of upper extremity is sprinkled with sulfanilamide crystals (approximately 2 gm.) and then covered with fine mesh gauze with petrolatum.

FIG. 5. Case 1. Appearance of right hand three weeks after application of amniotic membrane. No additional treatment was given. An area of necrosis overlies the distal head of the second metacarpal. This necrosis was due to excessive local pressure. Remainder of hand has full epithelization.

amniotic tissues have a longer useful life than skin homografts. This report concerns the successful clinical use of amniotic membranes in covering skin defects of large areas due to flame burns.

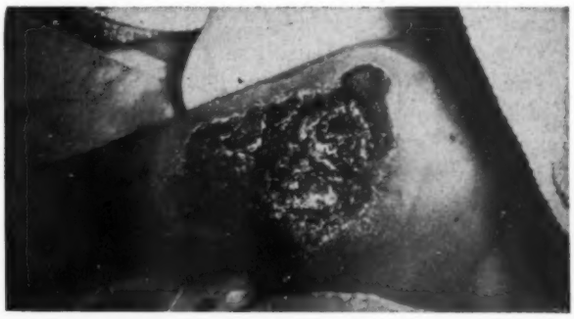

FIG. 6. Case 1. Appearance of right arm and shoulder four weeks after use of amniotic membrane. Crusted epithelization is present on a clean surface; 3 cm. circumferential healing is visible.

Placental tissues were available under seronegative aseptic conditions. Amniotic membranes were obtained at the time of an elective cesarean section with the grafting procedure scheduled accordingly. When normal vaginal deliveries occurred, placentas were procured and stored under aseptic conditions; they were wrapped in saline sponges, covered with dry towels and then placed in a freezer compartment. Tissues older than twelve hours were not used. When the amniotic membranes were

FIG. 7A. Case 11. Anterior view, nine months following original burn which had extended from nipple lines to knees around the entire body. Genitalia were gangrenous following thermal necrosis; distal 80 per cent of penis had sloughed. Scrotum, remaining penis and immediately adjacent tissues had been covered initially with amniotic membrane. No other grafted tissue was used. Full epithelization occurred.

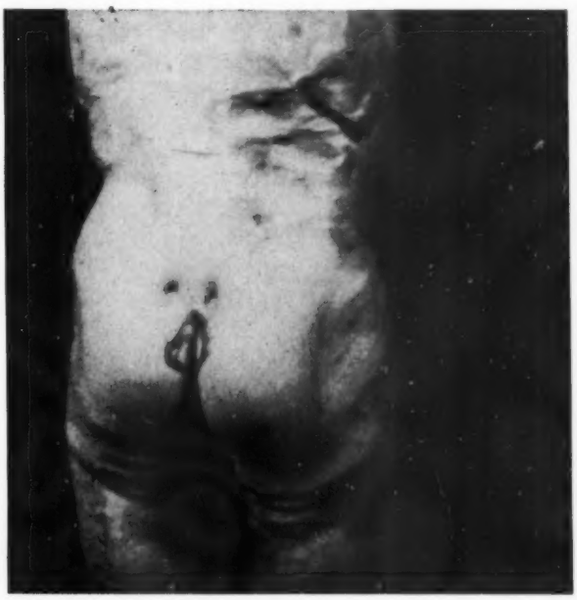

FIG. 7B. Case 11. Posterior view, taken at same time as Figure 7A. V-shaped area of granulating tissue overlying right costal cage is residue from amniotic graft. This area did not take autologous skin; healing was complete within three weeks by creeping epithelization. All other areas were secondarily grafted with autologous skin after healing of patient's thighs.

used they were washed in sterile normal saline solution at room temperature. (Fig. 1.) Tissues were warmed after removal from the refrigerator during the interval required by preparation of the patient. With the patient's areas cleansed and débrided (Figs. 2 and 3), the membranes were cut to pattern and applied either by wrapping (Fig. 2), with suture (Fig. 3), by snubbing or by a combination of pressure dressing and suture. It is to be noted that excessive pressure is harmful and produces ischemic necrosis (Fig. 5); immobilization is as important as coaptation. The serology and blood types of the patients and the viability or sex of the babies have been recorded for future study.

CASE REPORTS

CASE I. This patient, a thirty-eight year old woman, suffered flame burns of 60 per cent of the surface area of her body. Five weeks after the initial injury a dressing of amniotic membrane obtained at normal vaginal delivery was applied. (Fig. 4.) The use of three amniotic membranes on one occasion and five amniotic membranes on another was followed by epithelization of the forearms and hands (Fig. 5) and torso. Crusted epithelization of the legs and shoulders also occurred. (Fig. 6.) Preparations were being made for the use of autografts when this patient died from a pulmonary embolus.

CASE II. This patient, a six year old boy, had 65 per cent of the surface of his body damaged by flame burns. Amniotic membranes were obtained at cesarean section, and the first coverage with these membranes was started three weeks after initial trauma. The use of three amniotic membranes on one occasion and two amniotic membranes on another, together with the donor skin (from relatives), permitted full coverage. As a result, earlier use of the patient's own skin was possible. In several areas no additional grafting was required. Today he is well. (Fig. 7.)

SUMMARY

The use of amniotic membranes from cesarean or vaginal deliveries was practicable in two patients to cover defects of large areas due to flame burns.

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Pain in Peptic Ulcer

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PAIN in peptic ulcer is a commonly accepted indication for subtotal gastrectomy. We therefore decided to attempt to correlate the relationship of this symptom with the findings at operation and in the pathology laboratory. We also decided to evaluate the claim for the necessity of excising the ulcer in order to accomplish a satisfactory result.

The problem of the cause of pain in peptic ulcer has been investigated repeatedly, yet no universally acceptable conclusion has been reached. The following factors have been incriminated: (1) hydrochloric acid,[1,7,10,12,16,18] (2) motor dysfunction,[1,3,5–9,11,13,15,17,20,22,25,26] (3) local pathologic changes,[4,14,19,21,27] (4) gastritis and duodenitis,[2,16,23] and (5) hypoglycemia.[24]

We will not attempt to evaluate the validity of any of these factors. Our only purpose in this report is to relate the preoperative symptom of pain specifically to the degree of activity of the ulcer found at operation.

We analyzed a series of 101 patients who had undergone subtotal gastrectomies at the Veterans Administration Hospital, Brooklyn, for the usual indications. These cases were selected on the basis of adequate pathologic material. In eighty-six of the cases the complete area of gastric or duodenal disease was excised and examined grossly and microscopically. In fifteen of the cases the area of duodenal disease could not be resected because of technical difficulties; however, an adequate examination was carried out at the operating table via the open duodenum, so that this group is justifiably included in this report.

The subjective finding of pain is a difficult one to categorize. The patients were divided into two groups according to the measures needed to afford relief from pain up to the time of surgery. In group I were those patients in whom pain was a predominant symptom and who required extensive therapy for relief. In group II were those patients in whom pain was absent or trivial.

For purposes of analysis of pathologic material, an active ulcer was considered to be one in which there was interruption in continuity of the mucous membrane. An intact mucous membrane overlying an area of pathologic change was considered indicative of healed ulcer. In those patients with an intact mucous membrane, pathologic evidence of past ulceration was always found. The changes consisted of varying degrees of serosal scarring, adhesions to contiguous viscera, inflammatory infiltration and fibrosis of the wall of the bowel.

TABLE I
ACTIVITY OF ULCER AND DEGREE OF PAIN

Group	No. of Cases	Active Ulcers	Healed Ulcers
I, Severe pain...	64	26(40.6%)	38
II, No pain.....	37	19(51.4%)	18

In the sixty-four cases in group I in which pain was a major complaint, twenty-six or 40.6 per cent revealed active ulceration. In the thirty-seven cases in group II in which pain was absent or trivial, nineteen or 51.4 per cent revealed active ulceration. (Table I.) These data strongly suggest that the symptom of pain is an unreliable indicator of the state of activity of a peptic ulcer, and in addition cast doubt on the claim that pain in peptic ulcer depends upon the presence of an active ulcer.

We could likewise question the effectiveness of surgical therapy, particularly as to the necessity for the removal of the area of disease. It was thought that a short term follow-up would be valid in answering this question.

Seventy-three or 75 per cent of the 101 patients were followed up from four to seventeen months following surgery. Forty-eight patients

were in group I and twenty-five patients were in group II. Twenty-six of the forty-eight in group I had a healed ulcer at the time of operation and were found at follow-up to have been completely or markedly relieved of pain in 93 per cent. Twenty-two of those forty-eight in group I had an active ulcer at operation and were found by follow-up to have been completely or markedly relieved of pain in 96 per cent of cases.

TABLE II
FOLLOW-UP RESULT IN TERMS OF PAIN AND ACTIVITY OF ULCER AT OPERATION

Group	No. of Cases	Satisfactory Result (%)	Unsatisfactory Result (%)
I:			
Healed ulcer..	26	93	7
Active ulcer..	22	96	4
II:			
Healed ulcer..	14	100	0
Active ulcer..	11	91	9

TABLE III
EFFECT OF EXCISION OF ULCER ON END RESULT

Group	No. of Cases	Satisfactory Result (%)	Unsatisfactory Result (%)
Area of disease excised.....	39	92.3	7.7
Area of disease not excised...	9	100.0	0.0

All of the twenty-five patients in group II with active or healed ulcers at operation were completely free from pain, with the exception of one patient who was proved to have an active jejunal ulcer. (Table II.)

Subtotal gastrectomy therefore was equally effective in relieving pain in patients with peptic ulcer, healed or active, and the relief from pain afforded by the operation does not seem to depend upon the state of activity of the ulcer at the time of operation.

Despite the small number of patients followed up, some observations can be made on the importance of removing the area of disease in order to insure relief of pain. In thirty-nine of the patients in group I the area of disease was completely excised, resulting in relief of pain in thirty-six patients and persistence of pain in three. In nine of the patients in group I in which the area of disease was not excised, relief of pain was obtained in all cases. (Table III.) The impression obtained from this group of patients is that excision of the complete area of disease is not essential for the relief of pain in cases of peptic ulcer.

CONCLUSIONS

1. The cause of pain in peptic ulcer is not clear.
2. There is no correlation between the symptom of pain and the activity of the ulcer as observed at operation.
3. The relief of pain obtained by subtotal gastrectomy does not depend upon the degree of activity of the ulcer.
4. Excision of the diseased area is not essential for the relief of pain in patients with peptic ulcer.

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Occasionally a surgeon performs an appendectomy but fails to inspect the last 3 or 4 feet of the ileum. Especially when the appendix is not grossly diseased, this ileal inspection becomes imperative; if it is not done, a Meckel diverticulum may be overlooked and the patient will subsequently require additional surgery because of intestinal obstruction of one form or another caused by this diverticulum. (*Richard A. Leonardo, M.D.*)

SURGICAL REVIEW

Plastic Surgery for Closure of Decubitus Ulcers in Patients with Paraplegia

BASED ON EXPERIENCE WITH 1,000 CASES

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THE problem of decubitus ulcers in paraplegics has been recognized for many years. It was not until World War II, however, that an aggressive attack was made on these lesions. Since then—in the past ten years—great strides have been made, particularly in centers devoted to the care of large numbers of paraplegics. This paper deals with the results of the treatment of decubitus ulcers at the United States Veterans Hospital, Bronx, New York, during the past five years and is a continuation of the work previously reported from this service in 1947 (298 ulcers)[17] and 1951 (102 ulcers).[18] This report deals with an additional 600 decubitus ulcers, bringing the total to 1,000. Emphasis in the literature has been upon the initial closure of the ulcer, with little concern regarding recurrence. This presentation is concerned primarily with the surgical treatment of decubitus ulcers in paraplegics and the prevention of their recurrence.

ETIOLOGY

Brown-Sequard[11] called attention to the fact that bedsores in paraplegics are the result of pressure. Paget[46] agreed with this concept and explained the process on the basis of continued pressure forcing the blood out of the tissues, with resultant anoxia and necrosis of tissue. He stated that an ulcer would develop in fourteen days in a normal man who was kept in one position, but that the process is accelerated in old or debilitated patients, and in those with "paraplegia, pyaemia, acute pyelitis, and prolonged febrile illnesses." Charcot[14] was the first to postulate a neurogenic trophic factor. Munro[40] enlarged upon this and suggested that there are abnormal vascular reflexes due to disturbances in the sympathetic nerves below the neurologic level. The neurogenic trophic factor, if one exists, has never been satisfactorily demonstrated. The pressure required to arrest circulation in the skin was shown by Sir Thomas Lewis to be 50 to 60 mm. Hg. Freeman[26] showed that an ulcer would frequently develop after six to twelve hours of ischemia. It appears from the work of Mulholland et al.,[39] Gibbon and Freeman,[29] Conway et al.,[17] and Freeman[26] that the most important factors in the development of decubitus ulcers are pressure and malnutrition (including anemia, hypoproteinemia and avitaminosis). Almost all of the patients in this series had decubitus ulcers when admitted to this hospital. Sacral and trochanteric ulcers usually developed first, shortly after injury, while the patients were recumbent. Ischial ulcers developed later when the patients were in their wheelchairs. Many of the ulcers developed while the patients were at home after rehabilitation; a few developed while the patients were hospitalized. Factors influencing malnutrition were infection, other ulcers from which there was abundant loss of protein, and inadequate diet when the patients were out of the hospital. In a few cases, chronic alcoholism, drug addiction and the apparent desire for self-destruction (in severely paralyzed patients) adversely affected the diet. Sitting or lying for long periods in one position and contusions sustained in moving from bed to chair or from chair to car seat often initiated the pathologic process leading to ulceration.

After discharge from the hospital, those

patients who kept up their nutrition, cared for their skin and avoided undue trauma were found to be much less likely to develop ulcers than were those who did not take these precautions.

INCIDENCE

According to Kirk,[34] 598,000 soldiers were wounded in World War II; of this number, 1,400 were paraplegics (0.23 per cent), 75 per cent of whom had decubitus ulcers on return to the United States. It is interesting that in the Civil War there were 642 gunshot wounds of the spinal cord in the Union Army (0.25 per cent of all wounds), practically the same frequency as recorded in more recent times.

According to Gelb,[28] in 1952 the United States Public Health Service estimated that 83,000 paraplegics (from all causes) were alive in the United States. Prior to the introduction of the antibiotics, the life expectancy of paraplegic patients was very poor because of uncontrolled infections and their sequelae. The fact that these patients now can be kept alive for a more nearly normal life span is a tribute to antibiotic therapy, nursing care, nutritional management and surgical management (including neurosurgery, urology and plastic surgery).

Munro[40] reported on 126 paraplegics treated at the Boston City Hospital, in whom the incidence of ulcers was as follows: cervical cord lesions, 20 per cent; thoracic and lumbar cord lesions, 54 per cent; and cauda equina lesions, 12 per cent. Poer[47] reported that 57.1 per cent of seventy-seven patients with gunshot wounds of the spinal cord had decubitus ulcers.

The 600 ulcers reported herein were distributed as shown in Table I. The diseases or injuries which produced the paraplegia are shown in Table II. The various injuries produced fracture and/or dislocation of the vertebrae and partial or complete transection of the spinal cord. In 230 cases (66.7 per cent) the paraplegia was service-connected, i.e., it was sustained while the patient was in active military service.

TABLE I
LOCATION OF DECUBITIS ULCERS

Ischium	165	(27%)
Sacrum	145	(24%)
Trochanter	122	(20%)
Heel	46	(8%)
Knee	27	(4%)
Pretibial area	23	(4%)
Anterior superior ilial spine	22	(4%)
Malleolus	18	(3%)
Back (spinous process)	4	(6%)
Elbow	4	
Fibular head	4	
Chest	4	
Anterior thigh	4	
Calf	3	
Dorsum of foot	2	
Occiput	2	
Perineum	2	
Buttock	2	
Coccyx	1	
Total number of ulcers in 345 patients	600	

TABLE II
CAUSES OF PARAPLEGIA

Gunshot or shell fragment wound	140
Automobile or truck accident	77
Fall	42
Diving	25
Crush or blow	13
Infectious myelitis	12
Tumor of the spinal cord	10
Multiple sclerosis	6
Herniated nucleus pulposus	5
Adhesive arachnoiditis	4
Stab wound	2
Alcohol injection	2
Airplane crash	2
Arthritis of the spine	1
Aneurysm of spinal cord	1
Metastatic carcinoma	1
Osteogenic sarcoma of spine	1
Lymphocytic choriomeningitis	1
Total number of patients	345

PATHOLOGY

The essential details of the pathology of decubitus ulcers are that continued pressure over a bony prominence produces multiple thromboses of small vessels, with subsequent necrosis. The necrotic tissue gradually sloughs (or is débrided) and an ulcer results. As the necrosis and infection advance into the subcutaneous tissue, undermining develops and the underlying bone becomes exposed. In many cases the bursa overlying the bony prominence is the site first affected by the inflammatory process. In deep ulcers, the thickened, infected wall of the bursa is seen in the depths of the ulcer, often with the bone protruding through it. Osteomyelitis occurs and sequestra often are extruded from the wound. Yoeman and Hardy[54] emphasized the loss of tone of the vessels below the neurologic level as a result of initial spinal shock. This factor probably is of importance only in those ulcers which

develop shortly after injury. They state that ulcers are less likely to develop in patients with lesions high in the spinal cord than in those with lesions low in the cord. This point had been mentioned previously by Munro,[40,41] but there does not appear to be any pathologic explanation for it. It seems that the more exacting initial nursing care that the quadriplegic patient requires and usually receives may be responsible for the lower incidence of early ulcers. As quadriplegics are followed up over the years they show no lower incidence of ulcers than do paraplegics.

A wide variety of pathogenic organisms have been cultured from decubitus ulcers. The anaerobic streptococci are most commonly responsible for the rapid progression of ulcers by their development of extensive gangrene. Serial bacteriologic studies were not carried out in this series of patients except when indicated by sustained fever, cellulitis or excessive purulent drainage.

COMPLICATIONS OF PARAPLEGIA

The long term complications of paraplegia are many, including decubitus ulcers, chronic urinary tract infections and calcifications, demineralization of the skeleton, malnutrition, mental depression, amyloidosis, calcification of soft tissue and death.

Amyloidosis. Secondary amyloidosis is one of the serious complications of paraplegia and is presumed to be due to chronic infection. Thompson and Rice[51] reported on four paraplegics in whom amyloidosis was considered to be due to the triad of genitourinary infection, decubitus ulcers and chronic osteomyelitis. Bowman et al.,[10] in reporting four cases of amyloidosis in quadriplegics, believed that pyelonephritis was the most important factor in the genesis of amyloidosis, with decubitus ulcers "possibly contributing an added factor."

Newman and Jacobson[45] studied seven paraplegics who died and were autopsied in this hospital. Six of these patients had secondary amyloidosis and long-standing decubitus ulcers. Of these six, five had chronic pyelonephritis, cystitis, prostatitis and other chronic infectious processes. The sixth had no urinary tract infection, but had large decubitus ulcers. The seventh patient had chronic pyelonephritis, cystitis and prostatitis, but no decubitus ulcers and no amyloidosis. While one must be hesitant in drawing any conclusions from so small a series, it would appear that long-standing, large decubitus ulcers play a very important role in the development of secondary amyloidosis. The total mass of suppurative disease is probably the important factor. The greater the number and size of ulcers, the greater the infection and the likelihood of development of amyloidosis.

In this series, four of the twelve patients who died had extensive amyloidosis, and they had long-standing ulcers. Two patients in the series are still living with extensive amyloidosis. Both have had ulcers for many years and exhibit very poor healing capacity, so that attempted closure of several of the ulcers has met with failure.

These findings emphasize the importance of early closure of decubitus ulcers in the prevention of amyloidosis.

Calcification of Soft Tissue. Another common and important complication of paraplegia is calcification of soft tissue around joints below the neurologic level. This problem has interested investigators for many years. Déjerine et al.,[25] in 1919, reported a pathologic study of eleven paraplegics, 48 per cent of whom had calcification of soft tissue, always below the level of the cord lesion, and said never to involve the joints themselves. The calcification appeared soon after injury and progressed rapidly, developing in areas where there had been no previous hemorrhage or infection (unlike true myositis ossificans). Grossly, the calcium deposits and formation of new bone were seen to lie in the muscles surrounding the joints. Histologically, osteoblasts, cartilage cells and adult bone were seen. The pathogenesis was considered to be periosteal formation of new bone and metaplasia of the fibroblasts in the soft tissue. No explanation was given.

Soule[50] reported calcification of soft tissue in twenty-three of sixty-two paraplegics (39 per cent). There was no difference between these twenty-three patients and the other patients without ectopic calcification regarding the severity and level of the neurologic lesion, the time of operation, decubitus ulcers, urinary tract infection, age, or blood calcium or protein level. However, the average blood phosphorus level was 4.7 mg. per cent (control 3.9), and the average serum alkaline phosphatase was 6.2 mg. per cent (control 5.2).

Abramson,[1] at this hospital, reported on twenty paraplegics with x-ray evidence of calcification of soft tissue, of forty-eight patients so studied. There was no relation between the site and severity of the lesion and the location of the calcification. The earliest it was noted was twenty days after injury. The urinary calcium concentration was noted to increase steadily for thirty days after injury and stayed at a high level as long as function was not resumed. The ectopic calcification was also noted to progress only to a certain point and then to stabilize. Testosterone was used to try to diminish demineralization of the skeleton below the neurologic level, but this was unsuccessful. The most promising preventive measure was early mobilization through physical rehabilitation methods, and it was found that the urinary calcium concentration started to diminish as soon as ambulation was started. Roche and Jostes,[48] studying twenty-three paraplegics with ectopic calcification, also noted that ectopic bone formation stopped abruptly in those patients who recovered neurologic function and/or were mobilized early. In both these series of cases, urinary calculi were common. Liberson[37] studied thirty paraplegics and quadriplegics. Fifty-three per cent had calcification of soft tissue and 19 per cent had urinary calculi. The difference between this type of calcification and myositis ossificans was emphasized.

In the series of 345 patients reported herein, forty (11.6 per cent) were known to have calcification of soft tissue, often in multiple sites, but always below the neurologic level, as follows: hips, twenty-seven patients; ischial, seven; sacroiliac areas, eight; thigh muscles, six; knees, three; shoulders, two (in patients with C_4 cord lesions). In disagreement with the reports of others that the joints themselves were not involved, six joints in this series of patients were fused solidly because of periarticular ossification. Sixty-five patients (18.8 per cent) were known to have urinary tract calculi during this period. Fourteen patients had both calcification of soft tissue and urinary calculi. Blood calcium, phosphorus, alkaline and acid phosphatase levels were studied in all of these patients. The average blood levels were as follows: phosphorus, 4.2 mg. per cent (range 3.2 to 5.2), with a normal of 4.0 to 4.2; calcium, 9.6 mg. per cent (range 8.8 to 11.0), with a normal of 9.8 to 10.2. Alkaline and acid phosphatase studies were within normal limits. There was no consistent alteration of the blood levels in these patients, but it should be noted that these studies were conducted in patients with well established calcification of soft tissue.

Treatment of this condition consisted of excision of the calcified soft tissue, only when closure of an ulcer in the immediate vicinity was carried out. In a few of these cases the calcified soft tissue was considered to be the underlying "bony prominence" responsible for the development of the ulcer. One patient underwent excision of the dense mass of calcified material around a fused hip, resection of the head of the femur and a Judet type of arthroplasty. Convalescence was slow, but motion of the hip ultimately increased.

The best method of treatment for calcification of soft tissue to date appears to be its prevention by means of early mobilization.

Death. Twelve patients died in this hospital: four from amyloidosis, three from uremia, three from cerebral hemorrhage, one from osteogenic sarcoma of the spine, and one from carcinoma of the lung.

PREVENTION AND GENERAL TREATMENT OF DECUBITUS ULCERS

Since the treatment of decubitus ulcers until recent times was most discouraging, means of prevention were sought very early. Paget,[46] in 1873, tried a number of methods with variable success. Among these were: (1) special beds (a waterproof loose sheet over a water tank, a tight sheet, a firm mattress on boards, a divided mattress), all designed to equalize pressure on the dependent portion of the body; (2) frequent change of position; (3) pads of cotton wool over the bony prominences; (4) horseshoe-shaped felt cushions for sitting; and (5) hardening of the skin with nitrous ether and water, whiskey, tannic acid, chloroform and gutta-percha. Cope and Fres[20] tried a plaster mold of the posterior half of the body, also designed to equalize pressure on all points. This was not very successful. Astley[2] was apparently the first to suggest the use of sponge rubber cushions for sitting. McCormick[38] advised the use of vitamins B_1 and C to help maintain nutrition in these patients, and Mulholland et al.[39] published a classic paper on the importance of a high protein diet. When this was used, the patients were restored to positive nitrogen balance, their weight increased and

their decubitus ulcers improved. It is of historical interest to note that Paget recommended milk and bread, but "little or no meat." Gardner[27] developed an alternating pressure air mattress which has subsequently been used extensively, but has not proved satisfactory in our experience.

The most important factors in the prevention of decubitus ulcers in paraplegics appear to us to be maintenance of good nutrition with high protein, high vitamin intake, iron and whole blood when indicated; and avoidance of trauma, both sudden and long-standing, over bony prominences. The most significant achievement in the treatment of decubitus ulcers has been the development of methods of surgical closure. However, non-surgical therapy is also of considerable importance, particularly in the preoperative and postoperative management. Numerous chemicals have been used locally to protect the skin from breakdown and hasten the separation of the slough once an ulcer develops. Paget[46] used poultices of carrots and turnips, of linseed oil, and of bread and charcoal. He applied balsam of Peru to the granulating wound after the separation of the slough. Cope and Fres[20] suggested that the slough be allowed to separate by itself, but that débridement might be useful. They hopefully but erroneously stated that "débridement is all the surgery that is ever required." Mulholland et al.[39] and Guttman[31] advised relief of local pressure (with air mattress, rubber rings, frequent turning, sawdust bed, multiple pillows), local stimulation (by light massage, infrared and ultraviolet light, balsam of Peru, cod liver oil and gentian violet), and sulfonamides systemically. Harper and Cutler[32] recommended a high protein diet, whole blood, penicillin, débridement and closure of the ulcers by primary suture with wire. Kennedy[33] outlined the Army program of treatment of patients with lesions of the spinal cord. This plan, with the modifications reported by Conway et al.,[17] is basically the one used today, and will be discussed in some detail.

PREOPERATIVE CARE

The majority of the paraplegic patients at this hospital are cared for on the Paraplegic Section of the Physical Medicine and Rehabilitation Service, and their general needs and rehabilitation program are provided by the full time staff of this service. Routine care of the urinary tract (including catheter drainage, periodic pyelograms, cystoscopy and indicated surgery) is rendered by the Urology Service. Surgical closure of decubitus ulcers is undertaken as soon as possible after the development of the ulcers, but is postponed until it is certain that no urinary infection or calculus formation is present.

The patients receive high caloric, high protein diets, supplementary vitamins, and nursing care is directed at prevention of decubitus ulcers through frequent (every two hours) turning (when in bed or on Stryker or Foster frames) and keeping the skin dry and clean and pressure areas well padded. Split sponge rubber mattresses and multiple pillows are used on all the beds for comfort and for the equalization of pressure. Enemas are given twice a week to the patients who require them. Passive exercises are given daily to prevent stiffness of joints, and active exercises are used to maintain tone and strength of unparalyzed muscle groups. The patients who are able to do so are started on ambulation with braces, parallel bars and crutches as early as possible. The patients in wheelchairs sit on thick sponge rubber pillows with appropriate hollows cut in them to prevent pressure on bony prominences. Patients with decubitus ulcers over the sacral, trochanteric and ischial areas are kept recumbent until the ulcers are closed surgically.

The tilt table described by Climo[15] has been very useful in getting patients who have been recumbent for long periods adjusted to an erect posture. Its proved value in relieving pressure over bony prominences, by keeping the patients erect for significant periods of time during the day, has had limited usefulness, however, in dealing with large numbers of patients.

Early exploration of the site of the cord lesion is performed by the Neurosurgical Service, if it has not already been done prior to the patient's admission to this hospital. Since spasms in the extremities have caused separation of wound edges following surgery for ulcers, every effort is made to eliminate them before the surgical closure of decubitus ulcers is attempted. Anterior rhizotomy, first advocated by Munro,[42] is the most effective method of eliminating spasticity. Subarachnoid alcohol block is not selective enough and is not without danger due to the possibility of cephalad flow

of the alcohol. Subtotal spinal cordectomy has been used in four patients by Cooper[19] with good results, but it seems unnecessarily extensive for most cases. Obturator nerve section and femoral nerve crush are not as effective as rhizotomy, but these measures are used occasionally to relieve spasms in patients with incomplete lesions who have some voluntary function, sphincter control and/or erections, preservation of which could not be assured even if selective rhizotomy were done. Thorazine was not effective in controlling spasms postoperatively in three patients in whom it was tried. Demerol® (75 to 100 mg. every four hours) will control the spasticity to a certain degree, but has the obvious disadvantage of producing addiction if used for as long a period as is usually required postoperatively.

Decubitus ulcers are treated by the Plastic Surgical Service. They are surgically débrided as soon as demarcation is noted, and the wounds are dressed with Dakin's solution every four hours until a clean granulating bed is obtained. This usually occurs in about a week. Daily débridement with fine scissors or scalpel is done as required to rid the wounds of debris. Enzymatic débridement (streptokinase-streptodornase) was used locally in a small group of patients, but its use appears to be very limited, since surgical débridement is faster and simpler. Its value is limited to those wounds in which small bits of necrotic tissue are not easily removed by mechanical technic. Blood transfusions and ferrous sulfate are given pre- and postoperatively as required. Surgery is delayed until the hemoglobin is at least 12.5 gm. Preoperative bowel preparation (sulfaquinidine or aureomycin and enemas till clear) is carried out for ulcers in the area of the ischium.

SURGICAL TREATMENT

The surgical closure of decubitus ulcers was first suggested by Davis in 1938.[24] He used local advancement flaps to cover unstable scarred areas over the lumbosacral area, but his report included no paraplegics. The surgical attack on decubitus ulcers in paraplegics is one of the important contributions made by military surgeons during World War II and was first suggested by W. B. Scoville while he was Chief of the Neurosurgical Service at McCaw General Hospital. Lamon and Alexander[36] reported the first case so treated, a patient on Dr. Scoville's service with a sacral ulcer which was closed by excision and primary suture of the wound edges with silk. White, Hudson and Kennard[53] followed with a report of five sacral ulcers treated by excision and advancement or rotation of local flaps. It is interesting that they advised against exposing the bone or periosteum. Harper and Cutler[32] advised the same technic but used wire for the closure. Barker[3] reported on thirty ulcers treated by excision, split skin grafts, primary closure and rotation flaps. The split grafts held up poorly, but the flaps provided good coverage. In 1946, Croce, Schullinger and Shearer[22] reported on eight sacral ulcers treated by excision and closure with multiple regional flaps. Botterell et al.,[9] in Canada, reported 80 per cent success in the treatment of twenty sacral ulcers with rotation flaps. Barker, Elkins and Poer[5] reported 76.4 per cent healing following closure of seventy ulcers with split skin grafts, simple excision and closure, and rotation flaps. The patients were followed up for twelve months with "minimal breakdown." White and Hamm[52] reported 85 per cent healing of ulcers treated by simple closure, sliding flaps and rotation flaps. Gibbon and Freeman[29] reported on the closure of sixty-five ulcers in forty-three patients by means of excision and S-plasty closure. Barker[4] reported on the follow-up of twenty of eighty patients he had previously reported. There were no recurrences of small ulcers treated by excision and closure, but five of ten sacral ulcers treated with split skin grafts broke down repeatedly and needed flaps. Conway et al.[17] reported on the treatment of 298 ulcers in fifty-nine of sixty-five paraplegics at this hospital. Forty-nine patients had multiple decubitus ulcers. The ulcers had been present for an average of twelve months before surgery. Seventy-one per cent of all decubitus ulcers were closed successfully by various flap technics. Eighty-eight per cent of operations for sacral ulcers, 73 per cent of those for trochanteric ulcers and 47 per cent of those for ischial ulcers were successful. Results, analyzed as to type of surgical closure, were as follows: (1) with simple suture (small ulcers), 74 per cent healed; (2) Z-plasty closure, 50 per cent healed; (3) rotation flap with primary closure, 62.5 per cent healed; and (4) with rotation flap and split skin graft to the donor site of the flap, 75 per cent healed. The flaps used were small as compared to those used

today, but gave good coverage for a significant period of time. Croce and Beakes[21] treated 130 ulcers surgically and reported the best results with sliding or advancement flaps. They were the first to advise excision of the bony prominence, but this only in the case of ulcers over the spinous processes of the vertebrae. Kostrubala and Greeley[35] made a significant advance by recommending removal of the bony prominence under all ulcers treated surgically, namely, the posterior prominences of the sacrum, the entire greater trochanter and part of the ischial tuberosity. Ischial wounds were closed with local sliding flaps of muscle or fascia, and medially-based rotation flaps of skin and fat, with split skin grafts applied to the areas from which skin flaps had been elevated. Gordon[30] later reported 48 per cent healing of fifty ulcers with large rotation flaps with primary closure. Three had recurred by the time of publication. Bors and Comarr[8] reported on forty-seven ischial ulcers treated by excision of the ulcer and part of the ischium, rotation flap of gluteus muscle and primary closure of the skin. Nineteen patients required multiple operations, but 85 per cent eventually healed. Flap closure was advised for recurrences. Battle[6] advised the use of two triangular flaps for sacral ulcers, rotation flaps for trochanteric ulcers, and partial ostectomy and rotation flaps for ischial ulcers. In 1949, Blocksma, Kostrubala and Greeley[7] recommended subtotal ischiectomy and obturator internus muscle flap for ischial ulcers. The results were good, but small flaps were used and the split grafts were placed in areas where they were subjected to constant trauma from sitting.

Cannon et al.[13] reported on their experiences with 152 ulcers in seventy-five paraplegics. Thirty-four sacral ulcers (eighteen of them recurrent) were closed with advancement flaps, rotation flaps or tubed pedicles, all with thick-split skin grafts to the donor sites of flaps. The posterior sacral table was removed in all. Forty-five radical ischiectomies were done with thirty-two primary closures and twenty-seven rotation flaps. Complications were: hematoma, eleven; serous drainage, four; wound separation, four; infection, five; and partial necrosis of the flap, one. Comarr and Bors[16] carried ostectomy one step further when they reported on 100 ischial ulcers treated by removal of the entire ischium from the symphysis pubis to the acetabular rim. The wounds were closed primarily. Gelb[28] reported on 115 decubitus ulcers in fifty patients who had become paraplegic as a result of civilian injuries. Seventy-two per cent of these patients had decubitus ulcers. Spontaneous healing with conservative therapy occurred in 30 per cent. Operative treatment included ostectomy. Some wounds were closed primarily, others with pedicle flaps. Biceps femoris muscle flaps were used for ischial ulcers, with 96 per cent healing. The incidence of healing of ulcers in all locations was 84 per cent and of these, 21 per cent subsequently recurred.

Yoeman and Hardy,[54] in reporting their surgical results with ulcers in various locations, found ischiectomy, muscle flap and rotation flap with split skin graft to the donor site the best procedure for ischial ulcers. It was stated that the contralateral side frequently broke down subsequently, due to excessive pressure from sitting on that spot. This has been our experience also. In a recent article Campbell and Converse[12] reported on the use of bilateral "saddle" rotation flaps for ischial ulcers in ten patients. The ischia were only partly removed. It does not seem likely that these flaps will prove satisfactory in the long run because of their limited size. Crowley and Nickel[23] reported on the use of bilobed flaps (Zimany, 1953) for the closure of sacral ulcers. The flaps were relatively small and, in the light of experience gained from the authors' cases, appear to give inadequate insurance against recurrence.

The principles that the authors have found most important in the surgical treatment of decubitus ulcers are: (1) Excision of the ulcer and all the surrounding scar tissue. (2) Excision of the underlying bursa if present. (3) Removal of the underlying bone, which is often found to be hypertrophic, even after previous partial ostectomy (the posterior table of the sacrum, or at least the prominences, the entire greater trochanter of the femur, the entire ischium from the symphysis pubis to the rim of the acetabulum, the anterior superior iliac spine and part of the crest, the patella, and the spinous processes of the vertebrae). (4) Careful hemostasis (catgut ligatures in preference to cautery). (5) The use of a muscle flap to fill in deep holes and provide a well vascularized pad of soft tissue. For ischial ulcers, the authors use the biceps femoris muscle which is divided between clamps in its distal third and turned

1A 1B

FIG. 1. Small sacral ulcer (A), closed by excision, removal of underlying bone and advancement flap (B).

back on itself. It is sutured into the defect made by the ischiectomy. This also aids hemostasis in the depths of the wound. (6) Rotation of a *large* flap of skin and fat, based so that the circulation is not in question, and so that the scars will not be over the site of the original ulcer and will not be subjected to repeated trauma. The flaps are made as large as possible, so that in the event of recurrence of the ulcers, the flap can be rotated again without interference from scar. (7) Closure of the donor site of the flap by means of a thick-split skin graft, placed so that it is not over a bony prominence and therefore not liable to breakdown. (8) Suture of the flap with interrupted half-buried horizontal mattress sutures of No. 34 stainless steel wire which avoid suture holes in the skin of the flap and can be left in place for two or three weeks as required, with minimal tissue reaction. The grafts are sutured with silk which is tied over a bolus of cotton waste to effect pressure on the graft.

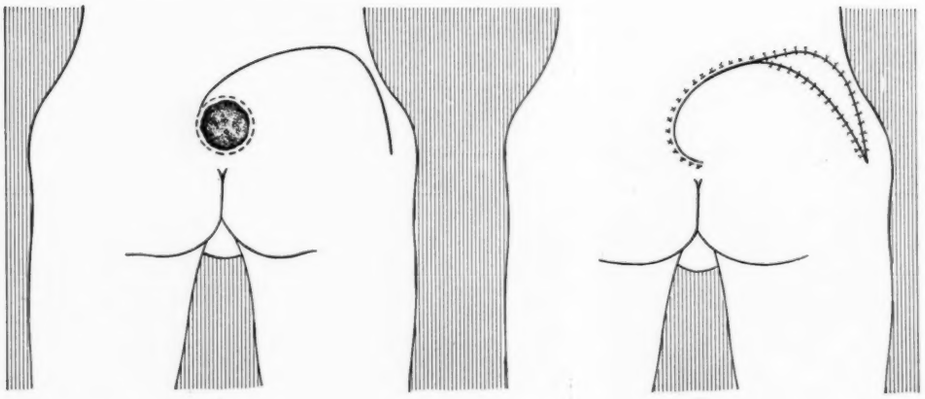
Thick-split skin grafts, perforated and wet-dressed, have been used for the temporary closure of large ulcers preliminary to permanent closure with rotation flaps. These serve to rid the wounds of infection and to stop the loss of fluid and protein from the ulcers. In some cases, these grafts have provided satisfactory and lasting closure. They have also proved useful for small ulcers in uncommon locations. Bipedicled flaps have proved useful for the closure of trochanteric ulcers which are too large to close with rotation flaps.

RESULTS OF TREATMENT (1950 TO 1955)

Three hundred forty-five patients with paraplegia and quadriplegia were treated in this hospital in the five-year period from January 1, 1950 to January 1, 1955. Of these, 225 (65.4 per cent) exhibited 600 decubitus ulcers, which either were present on admission, developed during prolonged hospitalization or developed after discharge from the hospital and necessitated readmission. Locations of the ulcers are shown in Table 1. One hundred fifty-eight of the ulcers were recurrent. Three hundred forty-seven of the 600 ulcers in these patients were treated surgically, 148 of them requiring more than one operation to achieve successful closure. A total of 415 operations were performed. Two hundred fifty-three ulcers were treated conservatively.

Ulcers in different locations were treated in several different ways during the five-year period. The results of these methods are reported according to areas. The term "success" is used to mean the percentage of ulcers that healed and did not recur during the period of observation (six months to five years).

Ulcers over the Sacrum. One hundred forty-five ulcers over the sacrum were treated by



2A 2B

FIG. 2. Diagram of the method of excision of sacral ulcer (A) (dotted line) and closure (B) with a large rotation flap. Note that the suture line and thick-split graft are placed over muscle, away from the site of the previous ulcer.

conservative measures, thick-split skin grafts and advancement or rotation flaps. Fifty of these ulcers were recurrent. One hundred twenty-three operations were carried out. Forty-four patients required more than one operation. Twenty-two (43 per cent) of the fifty-one ulcers treated by conservative measures (débridement, wet dressings and general supportive measures) healed. However, three to six months were required for healing. Also, only fifteen (68 per cent) remained closed for from one to five years and seven (32 per cent) recurred. Therefore, conservative treatment was successful in only 29 per cent of cases.

Seventy-four thick-split skin grafts were used for forty-five ulcers, with healing in forty-two (57 per cent). Twenty-seven remained healed for from six months to five years; fifteen (36 per cent) recurred and required further surgery. The success of this method, designed mainly for temporary coverage, was 36 per cent. (Figs. 1 to 4.)

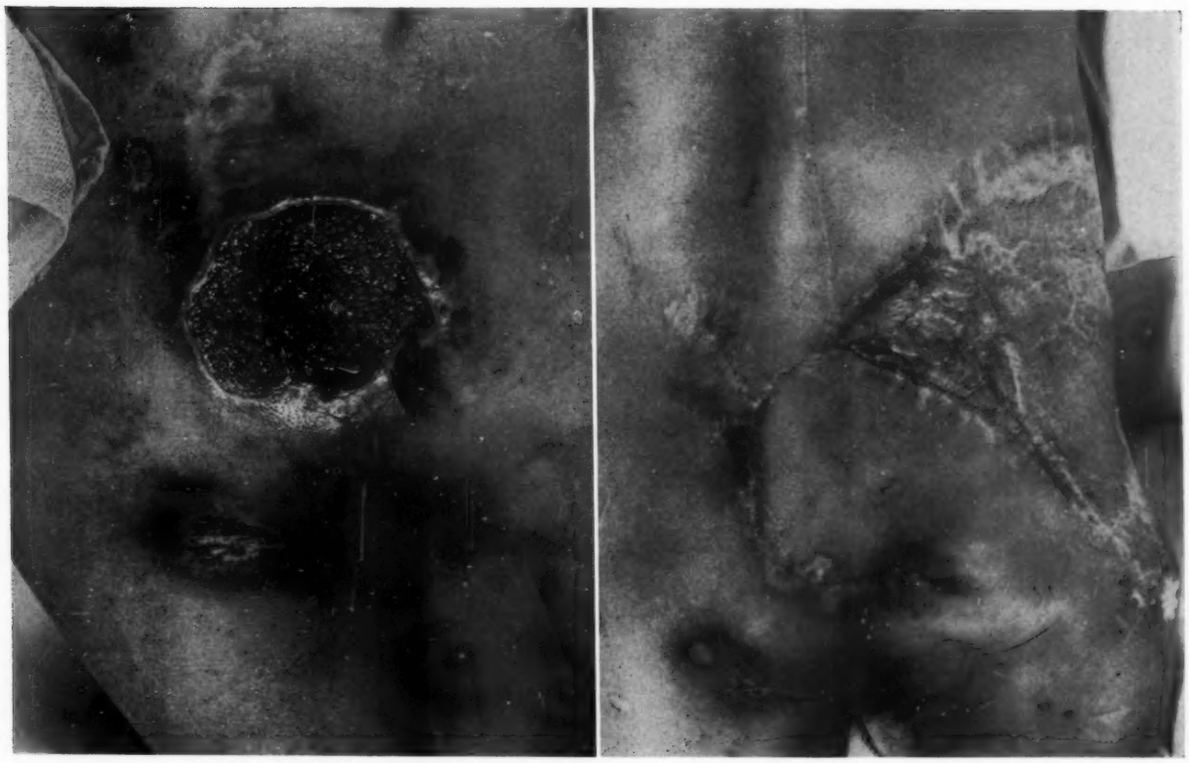
The remaining ulcers were treated by total excision of the ulcer and scar, resection of the underlying bone, and pedicle flap coverage. Six small ulcers were closed with advancement flaps, with healing of five (83 per cent), but recurrence of two ulcers (40 per cent), making this technic 50 per cent successful.

Four ulcers were closed with rotation flaps with primary closure, and all healed. Three have held up for four years, but one (25 per cent) recurred and required later closure.

Thirty-eight regional rotation flaps (with thick-split skin grafts applied to donor sites of flaps) were used, and thirty-six (95 per cent) healed. Five have remained closed for one to five years. Only four have recurred (11 per cent), *making this technic the best for sacral ulcers of all sizes with* 84 *per cent success.* (Table III.) All four recurrences were in thin quadriplegics who allowed their general condition to deteriorate after discharge from the hospital. Complications delaying healing were partial wound separation in one patient, sinus in two patients and hematoma in five. The two flaps that failed were in patients with lesions high in the cervical cord whose ulcers were large and whose general condition was poor despite strenuous efforts to improve it.

Two patients with lesions high in the thoracic cord had thoracoabdominal tubed pedicles prepared for the closure of large sacral ulcers which had recurred numerous times. The use of local rotation or advancement flaps was impossible because of extensive scarring in the area. In one patient the tube was used successfully and has held up well for nine months since inset. In the other patient, the ulcer healed spontaneously while the patient was prone during the preparation of the tube. It has not recurred in four years, and the tube has not been utilized.

Ulcers over the Trochanter. One hundred twenty-two ulcers over the greater trochanter of the femur were treated in eighty-two patients. Twenty-nine patients had bilateral trochanteric ulcers; twenty-two of these ulcers were recurrent. Fifty-seven patients were operated upon, twenty-nine requiring more than one operation. A total of 110 operations were performed. Thirty-two ulcers were treated

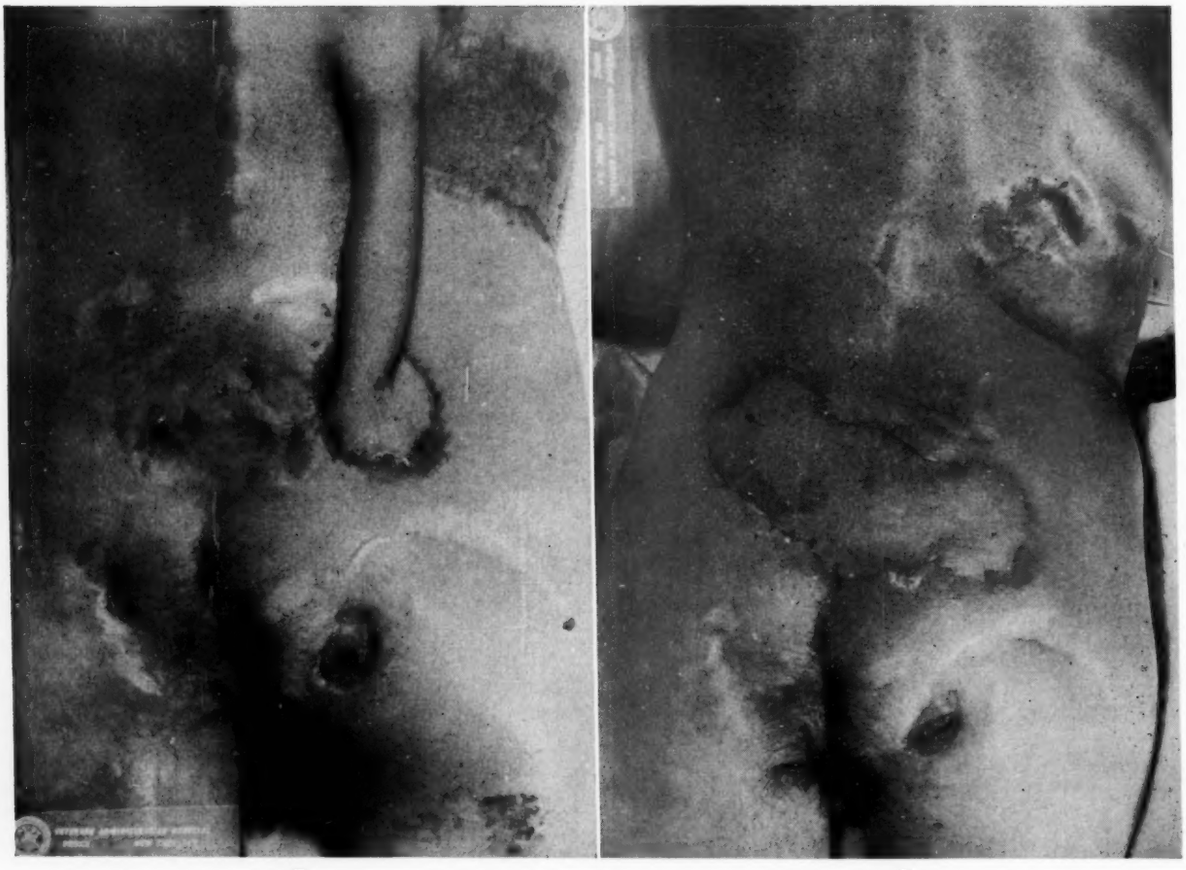


3A 3B

3C

FIG. 3. Large sacral ulcer (A) in a thin quadriplegic. It was treated by excision of the ulcer and underlying bone, and a large rotation flap (B). Following trauma, after the patient left the hospital, a recurrent ulcer was closed by secondary rotation of the same flap. Note the two healed split skin grafts at a distance, one from each operation. A subsequent recurrence was treated by rotation of a flap from the opposite side (C).

4A



4B 4C

FIG. 4. Large sacral ulcer in a thin quadriplegic patient (A). Extensive regional scarring prevented the use of a rotation flap. This was closed by the use of a large thoracoabdominal tubed pedicle (B and C). Note the recurrent ischial ulcers which followed partial ischiectomy and primary closure (left), and small rotation flap, without muscle flap (right). These were later treated by the method recommended in the text.

TABLE III
RESULTS OF TREATMENT OF 145 SACRAL ULCERS

Treatment	No. of Ulcers	No. Recurrent When First Seen or after Our Surgery	No. of Operations on Total No. of Patients	No. Operations Failed	No. Operations Healed	Healed but Later Recurred	Success (%)
Conservative therapy (no surgery)	51	5	0	29	22 (43%)	7 (32%)	29
Split skin graft	45	27	74	32	42 (57%)	15 (36%)	36
Excision of ulcer and bone with:							
Advancement flap, primary closure	6	0	6	1	5 (83%)	2 (40%)	50
Regional rotation flap, primary closure	4	2	4	0	4 (100%)	1 (25%)	75
Regional rotation flap, split skin graft at donor site of flap	38	25	38	2	36 (95%)	4 (11%)	84
Tubed pedicle	1	1	1 series	0	1 (100%)	0	100

conservatively. Twenty-two (69 per cent) healed but nine (41 per cent) of these recurred, making this form of treatment only 41 per cent successful. Sixty-one thick-split skin grafts were applied to forty-one ulcers. Fifty-six (92 per cent) healed, but thirty-six (64 per cent) of these recurred. Only 33 per cent have remained closed for from one to four years.

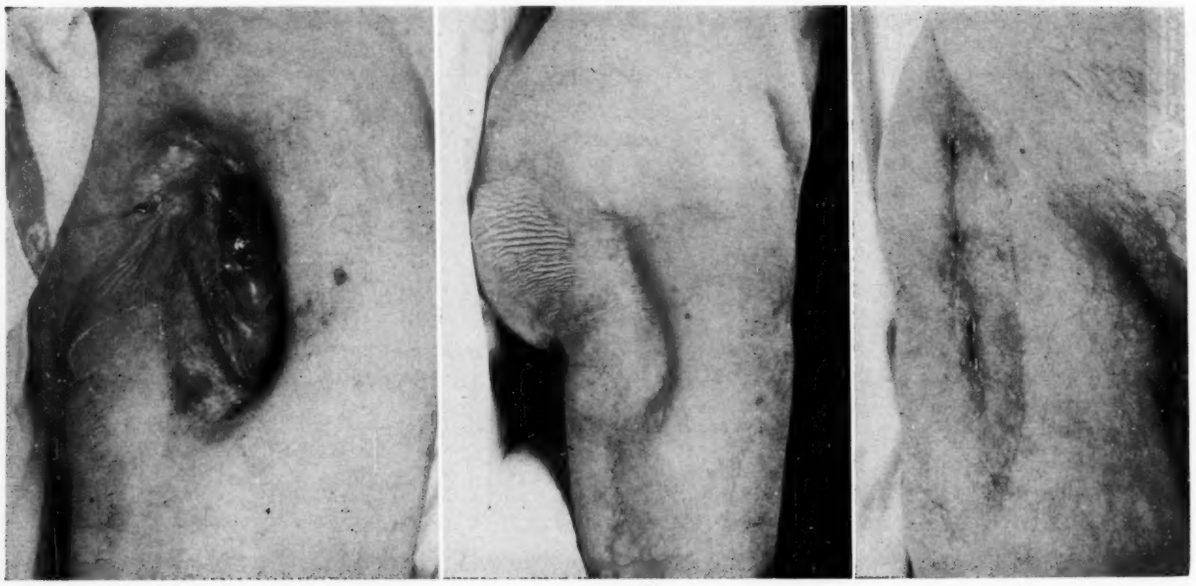
The remaining forty-nine ulcers were treated by excision of the ulcer, scar and bursa, and resection of the greater trochanter. Six small wounds could be closed primarily without tension, and five (83 per cent) of these healed. One (20 per cent), in a patient with amyloidosis, recurred after six months. The rest have remained closed for two to four years. The one failure was due to hematoma and dehiscence. Although the ulcers were small, primary suture was successful in only 67 per cent of cases.

Five large oval ulcers that could not be closed by rotation flaps were closed with large bipedicle flaps with skin grafts to the donor sites from which flaps had been elevated. (Figs. 5 to 7.) Five (80 per cent) healed, and none of these recurred so that this method yielded 80 per cent success. Hematoma accounted for the one failure and delayed the healing of one of the others.

The other thirty-eight wounds were closed with regional rotation flaps and split skin grafts to donor sites of flaps. Thirty-five (92 per cent) healed and have held up for six months to five years. Only two (6 per cent) recurred, *making this technic the preferred one for trochanteric ulcers with success in 86 per cent of cases.* (Table IV.) The two recurrences were in patients in whom only part of the greater trochanter had been removed. Complications were: partial separation of the wound edges two, sinus two, hematoma two, and infection two. Of the three failures, two were due to separation of the wound edges from severe flexor spasms and one was due to an infected hematoma. Successful closure was achieved subsequently with rotation flaps, after rhizotomy had eliminated the spasms.

Ulcers over the Ischium. There were 165 ulcers over the ischia in 100 patients. Twenty-three were right-sided, twenty-eight were left-sided and fifty-seven were bilateral. Forty-five ulcers (27 per cent) were recurrent. One hundred ten were operated upon (68 per cent); a total of 185 operations were performed. Forty-seven ulcers required more than one operation. (Figs. 8 and 9.)

Seventeen ulcers were treated conservatively, with healing of thirteen (77 per cent), but recurrence of ten of these (77 per cent) within two years, making this treatment only 18 per cent successful. Twelve thick-split skin grafts were applied to ten ulcers, eight of which healed (67 per cent) but six (75 per cent) recurred within two years. The method yielded success in only 11 per cent.



5A 5B 5C

FIG. 5. Large oval trochanteric ulcer (A) treated by excision, radical trochanterectomy and large bipedicle flap (B) with thick-split skin graft (C) to the site from which the flap was elevated.

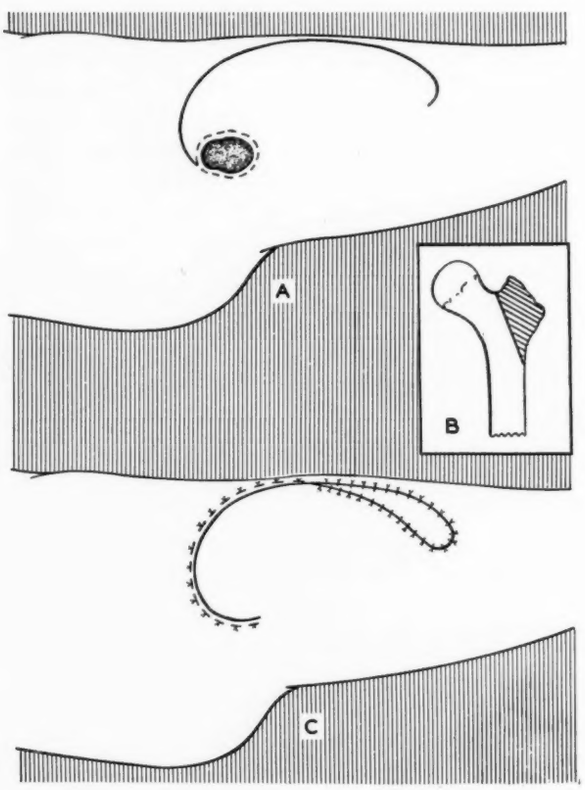


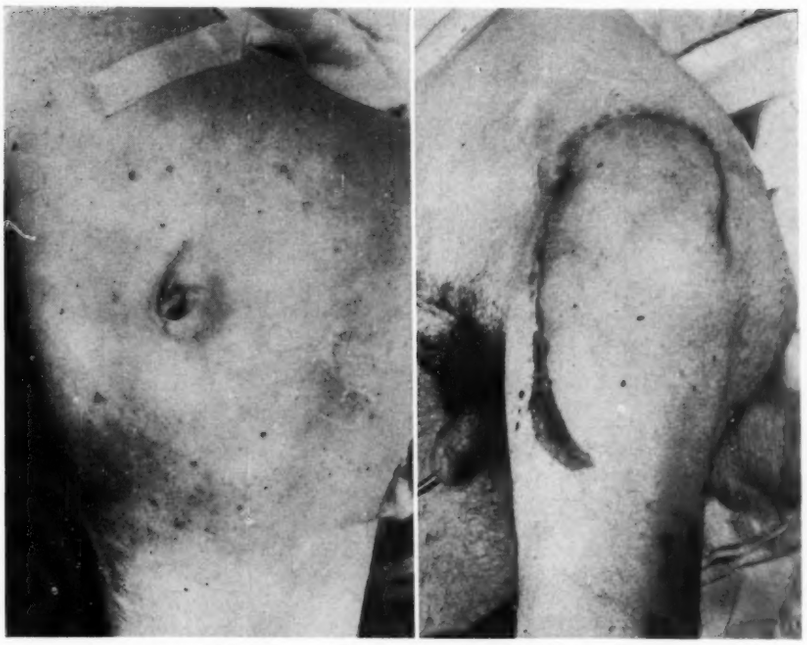
FIG. 6. Drawing showing excision of trochanteric ulcer (A) (dotted line) and closure with a large rotation flap using a thick-split skin graft to the donor site of the flap (C). The amount of trochanter removed (B).

In two very obese patients with partial sensation, small ulcers were treated by excision and primary closure without ischiectomy. One healed satisfactorily; the other recurred and was finally closed successfully with the same technic (67 per cent success). This procedure has extremely limited usefulness. (Figs. 10 to 12.)

The remaining 136 ulcers were excised along with the underlying bursa and varying amounts of the ischium. Partial ischiectomy and primary closure (direct suture of the wound edges) in fifty cases gave only 46 per cent success. All healed, but 45 per cent recurred within two years, probably because of pressure of the bone stump on the scar directly above it. Hematomata delayed healing in eight cases.

Total ischiectomy with primary closure in thirty-three cases was somewhat better, yielding 76 per cent success. Thirty-two (7 per cent) healed, but seven (22 per cent) recurred within two years. Hematomas delayed healing in ten cases. Eight of these procedures were done because the patients had flexor spasms which interdicted flaps, and rhizotomy was contraindicated or refused. Two patients had bilateral operations performed simultaneously. In two of these wounds hematomas developed.

Partial ischiectomy with rotation flap closure



7A 7B

FIG. 7. Trochanteric ulcer (A) treated by excision, radical trochanterectomy, large rotation flap with thick-split skin graft to donor site of flap. B, note that the suture line and skin graft are placed over muscle, away from the site of the original ulcer.

produced healing in three cases but all three recurred. Partial ischiectomy with muscle flap and primary closure achieved healing in two cases but one (50 per cent) recurred after six months. Total ischiectomy and bipedicle flap with thick-split skin graft to the donor site of the flap was used in one patient who had amyloidosis and a great deal of local scarring (from previous procedures) which prevented use of a rotation flap. The wound healed, but recurred in one year.

Partial ischiectomy, muscle flap, regional rotation flap and thick-split skin graft to the donor site of the flap was successful in 62 per cent of thirteen cases. (Table v.) All wounds healed but 38 per cent recurred within three years. *By far the best results were achieved by total ischiectomy, biceps muscle flap, large regional rotation flap and thick-split skin graft to donor site of flap.* This procedure was used in thirty-four cases, with healing of all and only one recurrence (3 per cent) to date, after from six months to four years. While it must be admitted that some of these patients have not been followed for a sufficiently long period to be sure that the ulcers will not recur, it is anticipated that the recurrence rate will be considerably lower than with any other method so far devised. *This surgical technic, with 97 per cent success, is looked upon as the procedure of choice for the treatment of ischial ulcers.*

Complications which delayed healing were: hematoma five, partial slough of the flap edge one, infected sinus three, and partial separation of the wound edges three.

Twenty-seven of the flaps were based medially and seven were based laterally. While the laterally-based flaps are theoretically better as far as the location of the scar is concerned, the wounds frequently separated slightly in the gluteal fold and a sinus developed which delayed healing. In two patients, the flaps were based inferiorly and laterally and the split grafts were placed over the neck of the femur where they broke down temporarily from pressure but subsequently have healed.

Ulcers over the Knee. There were twenty-seven ulcers in the area of the knee. Thirteen were right-sided, four were left-sided and five were bilateral. Sixteen were treated conservatively, with slow healing of fourteen (88 per cent), but recurrence of 14 per cent, making this method 75 per cent successful. In one patient with the hips fused in adduction ulcers

TABLE IV
RESULTS OF TREATMENT OF 122 TROCHANTERIC ULCERS

Treatment	No. of Ulcers	No. Recurrent When First Seen or after Our Surgery	No. of Operations on Total No. of Patients	No. Operations Failed	No. Operations Healed	Healed but Later Recurred	Success (%)
Conservative therapy	32	10	0	10	22 (69%)	9 (41%)	41
Split skin graft	41	9	61	5	56 (92%)	36 (64%)	33
Excision of ulcer, bursa, and trochanter with:							
Primary closure	6	0	6	1	5 (83%)	1 (20%)	67
Bipedicle flap, split skin graft at donor site of flap	5	1	5	1	4 (80%)	0	80
Regional rotation flap, split skin graft at donor site of flap	38	12	38	3	35 (92%)	2 (6%)	86

occurred over the medial surfaces of both knees with sinuses extending into the joints. Surgery was not feasible. They were treated conservatively and, at the time of this report, are almost completely healed. The remainder of the ulcers were over the anterior surface of the patella. (Table VI.) Eleven were closed surgically. Eight small superficial ulcers were closed by thick-split skin grafts, with primary healing in all, and recurrence in only one after ten months, giving success in 87 per cent of cases. Two ulcers which extended down to the patella and into the knee joint were treated with patellectomy, regional rotation flap and thick-split skin graft to the site from which the flap was rotated. In one patient partial separation of the wound edges over the condyles of the femur occurred. In the other, the anterior surface of the condyles were chiseled off to provide a smooth surface, and the wound healed *per primum*. There has been no recurrence in either case after one year. One patient had excision of the ulcer and the patella and closure by bipedicled flap with the relaxing incision and graft on the anterior thigh. It healed satisfactorily and has not recurred after one year. It was planned to use a rotation flap in this patient, but this was not possible because of the size of the wound. (Figs. 13 and 14.) *The technic of patellectomy and rotation flap was 100 per cent successful. This is looked upon as the procedure of choice for the surgical treatment of decubitus ulcers over the patella.*

Ulcers over the Pretibial Area. There were twenty-three pretibial ulcers in seventeen patients; four were right-sided, five were left-sided and seven were bilateral. Nine were treated conservatively with healing in all, but with recurrence in four (45 per cent). Conservative treatment was rewarded by success in 55 per cent of cases. Thirteen were closed with thick-split skin grafts, all of which healed. Of these, ten have held up for three to five years. Three recurred, making this technic only 77 per cent successful. (Table VII.)

One was treated by excision of the ulcer and two double-pedicled flaps with thick-split skin grafts placed over the relaxing incision on the calf. This wound healed well and has not recurred in two years, despite the fact that the scar is over the anterior surface of the tibia in the site of the original ulcer. This experience has developed a plan for the management of pretibial ulcers which allows a reasonable period for attempted healing by conservative measures and the use of excision and closure by bipedicled flap in those which fail to respond.

Ulcers over the Heel. There were forty-six ulcers over the heels; two were right-sided, eight were left-sided and eighteen were bilateral. Thirty-four were treated conservatively with poor success (59 per cent). *Eleven were treated by split skin graft with healing in all, but recurrence of two (18 per cent) after two years, making this technic 82 per cent successful and therefore the treatment of choice.* (Table

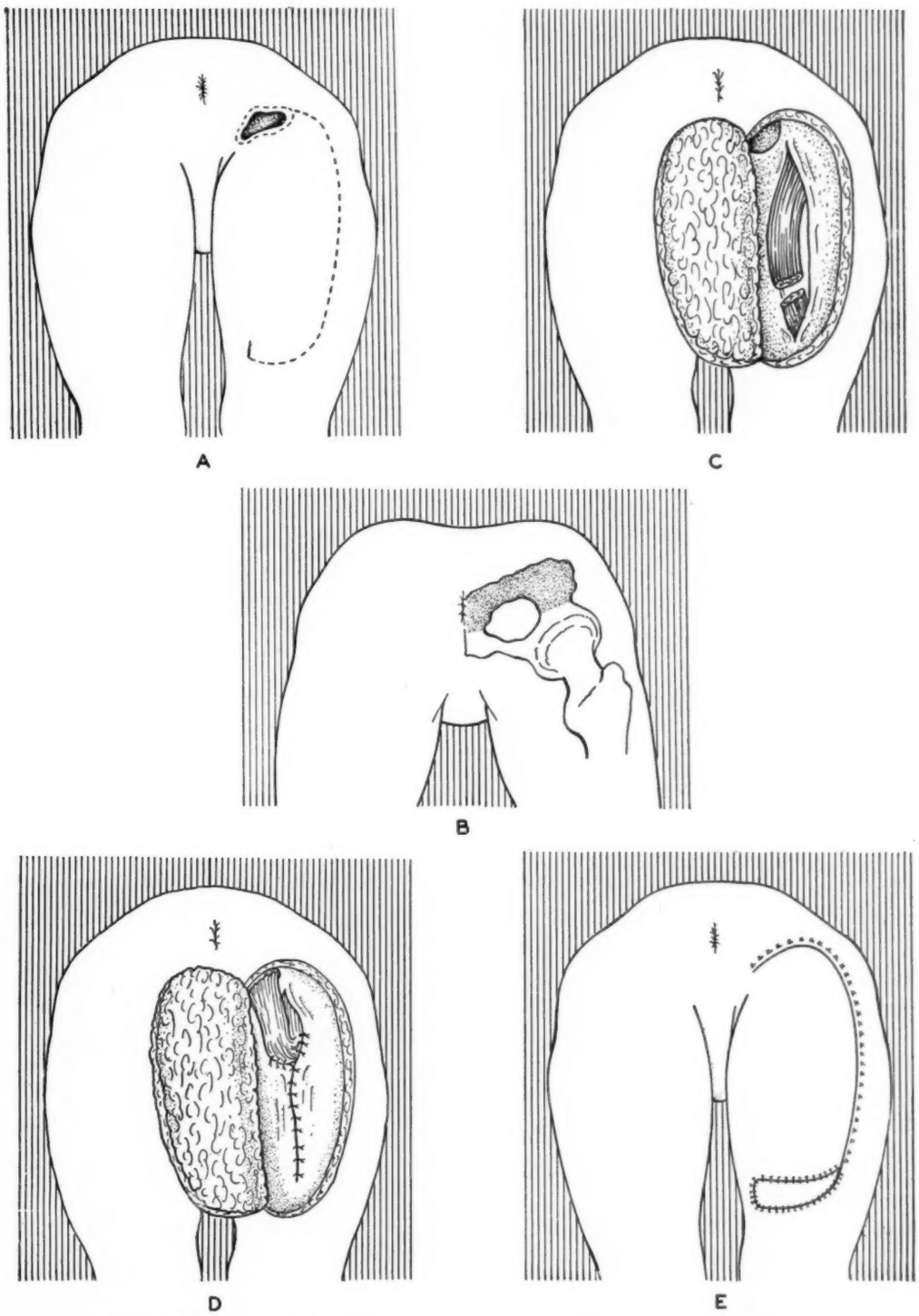
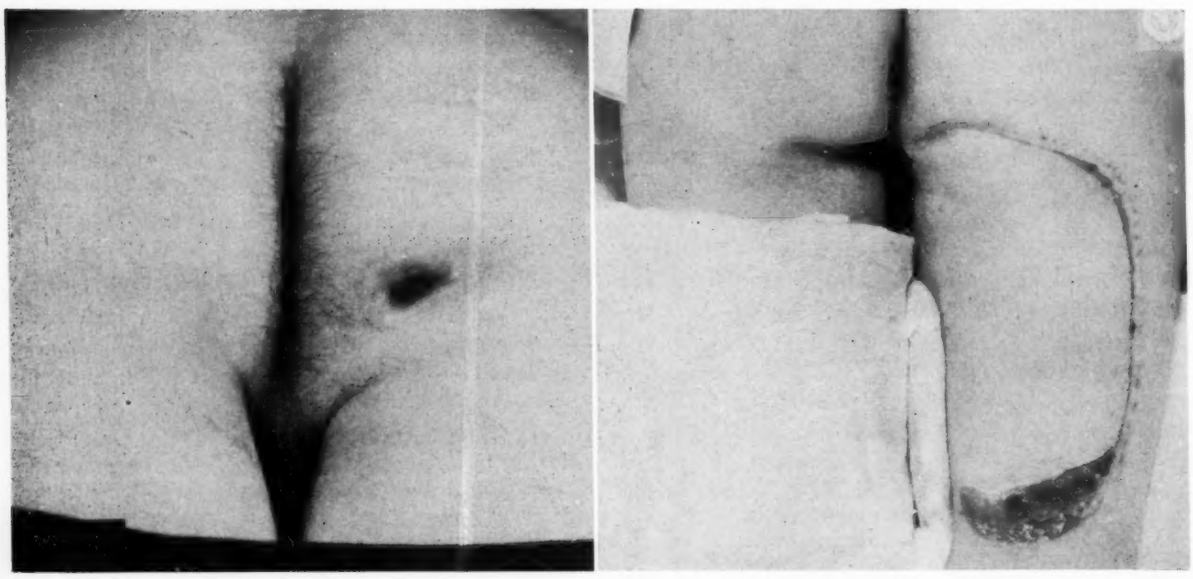


FIG. 8. Diagram showing steps in the closure of an ischial ulcer by the technic preferred in this clinic. A, line of excision and outline of rotation flap. B, shaded area of the ischium is the portion removed. C, flap turned back exposing the biceps femoris muscle, which has been divided low in the thigh. D, biceps muscle turned back on itself and sutured into the defect made by ischiectomy. E, closure with rotation flap. Thick-split skin graft is used distally to obviate tension on the flap.

9A 9B

FIG. 9. Large deep ischial and trochanteric ulcers (A). Ischial ulcer treated by excision of the ulcer and bursa, radical ischiectomy, biceps muscle flap, and rotation flap with thick-split skin graft to the donor site of the flap. The trochanteric ulcer was treated later. Note the large rotation flap previously used for closure of a sacral ulcer (B).



10A 10B

FIG. 10. Ischial ulcer treated by the technic shown in Figures 8 and 9. In this case the thick-split skin graft at a distance was lost due to hematoma. It was replaced with autogenous bank skin which healed satisfactorily.

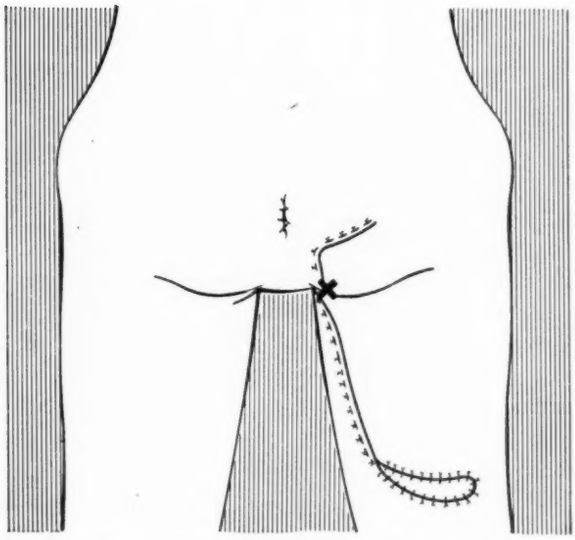


FIG. 11. Diagram of laterally based flap for closure of ischial ulcer. The "X" marks the location of partial wound separation which delayed the healing of most of these wounds. Note the absence of scarring over the lateral thigh, however.

VIII.) One of the recurrences was treated with partial ostectomy of the os calcis and thick-split graft. The graft healed but the ulcer recurred after two years.

Ulcers over the Anterior Superior Iliac Spine. There were twenty-two ulcers over the anterior superior iliac spines in seventeen patients; four ulcers were right-sided, six were left-sided and six were bilateral. Ten were treated conservatively, with slow healing in six (60 per cent). Three were covered with split skin grafts. All healed, but two recurred after one year, giving success in 33⅓ per cent of cases. Seven were treated by excision of the ulcer, resection of the anterior superior spine and part of the crest, and primary closure. (Table IX.) All healed, despite one hematoma. There has been no recurrence after as long as three years. *The success of this method (100 per cent) appears to make it the ideal method of management for decubitus ulcers over the anterior iliac spine which do not respond to conservative treatment in a reasonable period of time.*

One ulcer was closed by Z-plasty. The wound healed primarily and there has been no recurrence in four years. (Fig. 15.) Another was closed successfully by excision of the ulcer and bone, and closure by an advancement flap. It has not recurred in two years.

FIG. 12A. Ischial ulcer treated by excision of the ulcer and bursa, radical ischiectomy, biceps muscle flap and laterally based rotation flap with thick-split skin graft at a distance.

FIG. 12B. Same patient as above. Wound healed primarily and there has been no recurrence of the ulcer.

Ulcers over the Back. There were four ulcers over the spinous processes of the vertebrae at the level of L1, L1, L2 and L3, respectively. Cord levels were C6, C6, L1 and L3, respectively. Two patients had had exploratory

TABLE V

RESULTS OF TREATMENT OF 165 ISCHIAL ULCERS

Treatment	No. of Ulcers	No. Recurrent When First Seen or after Our Surgery	No. of Operations on Total No. of Patients	No. Operations Failed	No. Operations Healed	Healed but Later Recurred	Success (%)
Conservative therapy	17	0	0	4	13 (77%)	10 (77%)	18
Split skin graft	10	2	12	4	8 (67%)	6 (75%)	17
Excision of ulcer and primary closure	2	1	3	1	2 (67%)	0	67
Excision of ulcer and bursa with:							
Partial ischiectomy, primary closure	50	5	50	0	50 (100%)	27 (54%)	46
Total ischiectomy, primary closure	33	8	33	1	32 (97%)	7 (22%)	76
Partial ischiectomy, rotation flap, split skin graft at donor site of flap	3	0	3	0	3 (100%)	3 (100%)	0
Partial ischiectomy, muscle flap, primary closure	2	0	2	0	2 (100%)	1 (50%)	50
Total ischiectomy, bipedicle flap, split skin graft at donor site of flap	1	1	1	0	1 (100%)	1 (100%)	0
Partial ischiectomy, muscle flap, rotation flap, split skin graft at donor site of flap	13	7	13	0	13 (100%)	5 (38%)	62
Total ischiectomy, muscle flap, rotation flap, split skin graft at donor site of flap	34	14	34	0	34 (100%)	1 (3%)	97

TABLE VI

RESULTS OF TREATMENT OF TWENTY-SEVEN ULCERS OVER THE KNEE

Treatment	No. of Ulcers	No. Recurrent When First Seen or after Our Surgery	No. of Operations on Total No. of Patients	No. Operations Failed	No. Operations Healed	Healed but Later Recurred	Success (%)
Conservative therapy	16	0	0	2	14 (88%)	2 (14%)	75
Split skin graft	8	4	8	0	8	1 (13%)	87
Excision of ulcer, patellectomy, rotation flap, split skin graft at donor site of flap	2	0	2	0	2 (100%)	0	100
Excision of ulcer, patellectomy, bipedicle flap, split skin graft at donor site of flap	1	0	1	0	1	0	100

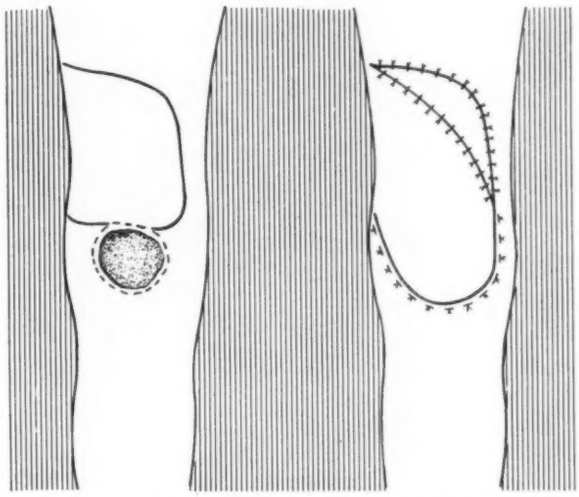
laminectomies and two had had anteroposterior rhizotomies. Each ulcer occurred over the prominent spinous process at the inferior end of the dorsal scar. One patient had an ulcer over a prominent spinous process adjacent to an osteomyelitic sinus. This wound was treated by split skin graft but recurred in three months because of persistent drainage. In the other three cases the ulcers were excised along with the underlying spinous processes. Wounds were closed by primary suture in one case, by S-plasty in one case, and by regional rotation flap with thick-split graft to donor site of flap in one case. All healed well and have not recurred after two years. *The technic of excision of ulcer and spinous process was therefore successful in* 100 *per cent of cases.* (Table x.)

Ulcers over the Malleolus. There were eighteen ulcers over the malleoli of thirteen patients; three were right-sided, five were left-sided and five were bilateral. Four were treated conservatively with slow healing of 50 per cent. Twelve were covered with thick-split skin grafts, with healing of ten, and recurrence of two of these, giving success of 67 per cent. Skin grafts have held up for as long as four years. Two lateral malleolar ulcers were closed by excision of the ulcer and the malleolus, and regional rotation flaps with skin graft applied to the donor site of the flap. This procedure gave excellent results, and there have been no recurrences in three years

Ulcers over the Fibular Head. There were four ulcers over the head of the fibula, two right-sided and two left-sided. One was treated conservatively and healed after six months. Five operations were performed. One patient had excision of the ulcer and primary closure. The wound healed, but the ulcer recurred after one year and was closed with a split skin graft. The second patient had excision of the ulcer and split skin graft. (Table xi.) Both wounds healed and have not recurred in two years. The third patient had excision of the ulcer and the fibular head with advancement flap and primary closure. The wound separated but was closed with a rotation flap which remained healed until the patient's death two years later.

Ulcers over the Calf. There were three ulcers over the calf. All were closed with thick-split skin grafts and have not recurred after three years.

Ulcers over the Elbow. Four ulcers over the olecranon were treated in two quadriplegic patients. (Table xii.) Three were treated by débridement and conservative treatment, and these have not recurred after two years so that 67 per cent of success was achieved by this method. The other was treated by excision of the ulcer and the olecranon bursa. The wound



13A 13B

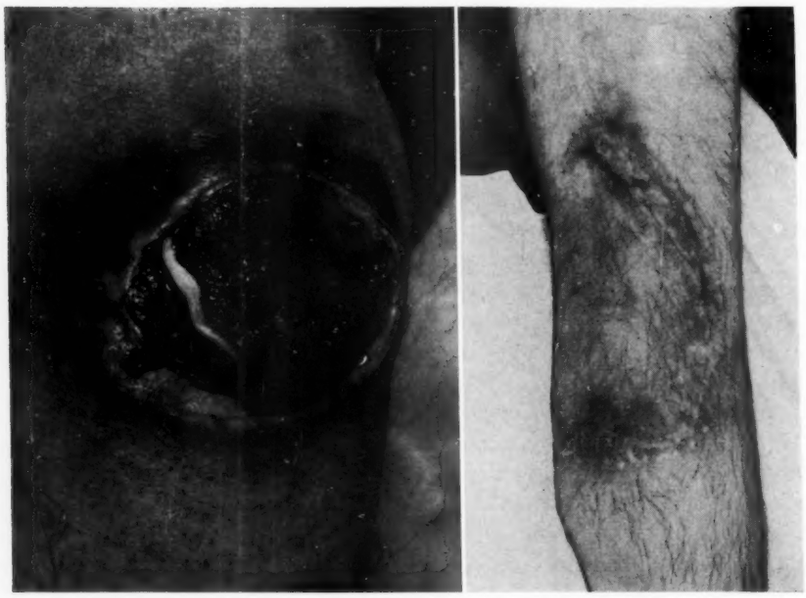
Figs. 13A and B. Diagram of the surgical treatment of a large ulcer over the knee by excision of the ulcer and the patella, closure of the joint with a fascial flap, and coverage with a rotation flap using a thick-split skin graft at a distance, over the padded anterior thigh.

healed but because of the patient's persistent leaning on the elbow, it reopened after two years. The patient left the hospital against advice before the recurrence could be treated.

Ulcers over the Occiput. Two occipital ulcers developed early after injury in two quadriplegic patients who were kept on Stryker frames. Both ulcers healed with conservative treatment and have not recurred in two years.

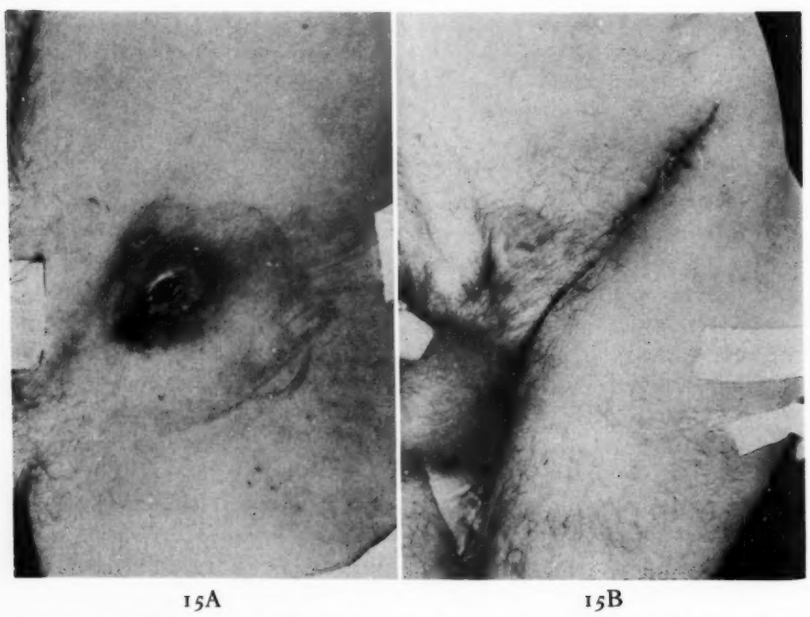
Ulcers over the Perineum. Two perineal ulcers were treated. One, in a patient who had undergone ischiectomy on both sides, was treated by excision and primary closure, with satisfactory healing and no recurrence in four years. The other, in a patient with amyloidosis, has remained open despite intensive conservative therapy.

Ulcers over the Chest Wall. Four ulcers on the anterior and lateral chest wall were seen in three patients with high thoracic lesions. One, on the lateral side of the chest of an obese paraplegic developed from pressure against the arm of his wheelchair. It was treated by débridement and conservative therapy and



14A 14B

FIG. 14. Large ulcer over the knee exposing the entire patella and extending into the joint (A). It was treated by excision of the ulcer, partial condylectomy, total patellectomy, fascial flap and rotation flap with thick-split skin graft at a distance (B). Primary healing, full range of motion and no recurrence. In earlier experience amputation was advised for this type of ulcer.



15A 15B

FIG. 15. Ulcer over the anterior superior iliac spine (A). Treated by excision of the ulcer, anterior spine and part of the iliac crest, and primary closure (B).

healed in four months. It has not recurred. Two ulcers appeared over the anterior rib cage of a cachetic quadriplegic (level C_4) while he was prone following the closure of a sacral ulcer. They healed with conservative therapy and have not recurred in one year. One ulcer of the anterior chest in a third patient failed to close after split skin graft, but was closed by excision of the ulcer and rotation flap. It has not recurred in four years.

TABLE VII

RESULTS OF TREATMENT OF TWENTY-THREE PRETIBIAL ULCERS

Treatment	No. of Ulcers	No. Recurrent When First Seen or after Cur Surgery	No. of Operations on Total No. of Patients	No. Operations Failed	No. Operations Healed	Healed but Later Recurred	Success (%)
Pretibial:							
Conservative therapy	9	0	0	0	9	4 (45%)	55
Split skin graft	13	5	13	0	13 (100%)	3 (23%)	77
Excision of ulcer, two bipedicle flaps, split skin graft at donor site of flap	1	0	1	0	1	0	100

TABLE VIII

RESULTS OF TREATMENT OF FORTY-SIX ULCERS OVER THE HEEL

Treatment	No. of Ulcers	No. Recurrent When First Seen or after Our Surgery	No. of Operations on Total No. of Patients	No. Operations Failed	No. Operations Healed	Healed but Later Recurred	Success (%)
Heel:							
Conservative therapy	34	4	0	4	30 (88%)	10 (33%)	59
Split skin graft	11	5	11	0	11 (100%)	2 (18%)	82
Excision of ulcer and parts of os calcis, split skin graft	1	1	1	0	1 (100%)	1 (100%)	0

TABLE IX

RESULTS OF TREATMENT OF TWENTY-TWO ULCERS OVER ANTERIOR SUPERIOR ILIAC SPINE

Treatment	No. of Ulcers	No. Recurrent When First Seen or after Our Surgery	No. of Operations on Total No. of Patients	No. Operations Failed	No. Operations Healed	Healed but Later Recurred	Success (%)
Conservative therapy	10	0	0	4	6 (60%)	0	60
Split skin graft	3	0	3	0	3 (100%)	2 (61%)	33
Excision of ulcer, anterior superior spine, with:							
Primary closure	7	2	7	0	7	0	100
Z-plasty	1	0	1	0	1 (100%)	0	100
Advancement flap	1	0	1	0	1	0	100

TABLE X

RESULTS OF TREATMENT OF FOUR ULCERS OVER THE BACK AND EIGHTEEN ULCERS OVER THE MALLEOLUS

Treatment	No. of Ulcers	No. Recurrent When First Seen or after Our Surgery	No. of Operations on Total No. of Patients	No. Operations Failed	No. Operations Healed	Healed but Later Recurred	Success (%)
Back (spinous process):							
Split skin graft	1	1	1	0	1	1 (100%)	0
Excision of ulcer and spinous process with:							
Primary closure	1	0	1	0	1 (100%)	0	100
S-plasty	1	0	1	0	1	0	100
Rotation flap, split skin graft at donor site of flap	1	0	1	0	1	0	100
Malleoli:							
Conservative therapy	4	0	0	0	4 (100%)	2 (50%)	50
Split skin graft	12	4	12	2	10 (83%)	2 (20%)	67
Excision of ulcer and malleolus, rotation flap, split skin graft at donor site of flap	2	0	2	0	2 (100%)	0	100

TABLE XI

RESULTS OF TREATMENT OF FOUR ULCERS OVER THE FIBULAR HEAD

Treatment	No. of Ulcers	No. Recurrent When First Seen or after Our Surgery	No. of Operations on Total No. of Patients	No. Operations Failed	No. Operations Healed	Healed but Later Recurred	Success (%)
Conservative therapy	1	0	0	0	1	0	100
Split skin graft	(1)	1	1	0	1	0	100
Excision of ulcer with:							
Primary closure	1	0	1	0	1 (100%)	1 (100%)	0
Split skin graft	1	0	1	0	1	0	100
Excision of bone, advancement flap	1	0	1	0	1	1 (100%)	0
Excision of bone, rotation flap, split skin graft to donor site of flap	(1)	1	1	0	1	0	100

Ulcers over the Anterior Thigh. There were four ulcers over the anterior thigh in two patients. Two closed with conservative therapy and two were closed by thick-split skin grafts. None has recurred in two years.

Ulcers over the Foot. Ulcers on the dorsum of the foot are decidedly rare. There were two in this series of patients. One responded to conservative measures. The other was healed by thick-split skin graft. Neither has recurred in four years.

Ulcers over the Buttock. In two patients who had undergone previous closure of ischial and trochanteric ulcers, ulcers appeared between the ischial and trochanteric scars. In one case the ulcer was located over the neck of the femur and was thought to have resulted from pressure over pointed, irregular calcification

TABLE XII

RESULTS OF TREATMENT OF ELEVEN MISCELLANEOUS ULCERS

Location and Treatment	No. of Ulcers	No. Recurrent When First Seen or after Our Surgery	No. of Operations on Total No. of Patients	No. Operations Failed	No. Operations Healed	Healed but Later Recurred	Success (%)
Calf:							
Split skin graft	3	0	3	0	3 (100%)	0	100
Elbow:							
Conservative therapy	3	1	0	0	3 (100%)	1 (33%)	67
Excision of ulcer and olecranon bursa, primary closure	1	0	1	0	1 (100%)	1 (100%)	0
Occiput:							
Conservative therapy	2	0	0	0	2 (100%)	0	100
Perineum:							
Conservative therapy	1	0	0	0	1 (100%)	0	100
Excision of ulcer, primary closure	1	0	1	0	1 (100%)	0	100

TABLE XIII

RESULTS OF TREATMENT OF NINE MISCELLANEOUS ULCERS

Location and Treatment	No. of Ulcers	No. Recurrent When First Seen or after Our Surgery	No. of Operations on Total No. of Patients	No. Operations Failed	No. Operations Healed	Healed but Later Recurred	Success (%)
Chest wall:							
Conservative therapy	3	0	0	0	3 (100%)	0	100
Split skin graft	1	0	1	1	0	0	0
Excision of ulcer, rotation flap, split skin graft at donor site of flap	1	1	1	0	1 (100%)	0	100
Anterior thigh:							
Conservative therapy	2	0	0	0	2 (100%)	0	100
Split skin graft	1	0	1	0	1 (100%)	0	100
Foot:							
Conservative therapy	1	0	0	0	1 (100%)	0	100
Split skin graft	1	0	1	0	1 (100%)	0	100
Buttock:							
Excision of ulcer and bone, rotation flap, split skin graft at donor site of flap	2	2	2	1	1 (50%)	0	50
Coccyx:							
Conservative therapy	1	1	0	0	1 (100%)	0	100

of soft tissue in this area. It was treated successfully by excision of the ulcer and the ectopic calcification, and by closure with a rotation flap and the application of a thick-split skin graft to the donor site of the flap. The ulcer in the other patient extended down via a sinus to the trochanteric area. Several attempts at closure by trochanterectomy and rotation of a large flap have been unsuccessful due to a hematoma which invariably undermines the flap. (Table XIII.)

Ulcers over the Coccyx. One ulcer developed over the coccygeal tip in a patient who had undergone total ischiectomy on both sides with rotation flaps. It was treated conservatively and healed in about six weeks. It has not recurred. The patient sits upon a sponge rubber cushion with a hole cut in it to avoid pressure over the tip of the coccyx.

Study of a bony pelvis reveals that if the entire ischium is removed bilaterally, except for the portion that helps make up the acetabular rim, the bones that will be closest to the skin with the patient sitting are the symphysis pubis and the coccyx. The soft tissue of the perineum, with the underlying rigid prostate, is actually the most dependent tissue in such a patient. It is to be expected, then, that ulcers might develop in these locations. So far this has happened in two patients and we may anticipate its occurrence in more, if the dependent areas are not protected by a hollowed-out thick rubber cushion when the patient is sitting.

POSTOPERATIVE CARE

After operation, patients who have had pedicle flap coverage of sacral, trochanteric and ischial ulcers are kept immobilized for about three weeks, in the prone position for sacral and ischial wounds, and prone or on the contralateral side in the case of trochanteric wounds. Pressure on the operative site and the flexion of the hips is prevented by a large bulky spica dressing of thick gauze and cotton pads, 4 inch gauze rolls and elastic bandages. Plaster is not used because of the great danger of pressure sores developing inside casts in paraplegics. Enemas are withheld and the patients are placed on low residue diets or given paregoric, or both for about two weeks to prevent contamination of the operative area by fecal material.

Procaine penicillin, 300,000 units, and dihydrostreptomycin, 0.5 gm., are given intramuscularly twice daily until all the sutures have been removed and there is no evidence of infection. If infection occurs, cultures are taken of any exudate, and the proper antibiotic is determined by sensitivity studies. The patients are given multivitamin capsules (two daily) and 300 mg. of ascorbic acid by mouth. Vitamin K has been given to some patients for two days before and five days after operation but has not appeared to effect the incidence of occurrence of hematoma.

Unless there is evidence of hematoma or infection, as manifested by fever or soiling of the dressing with blood or exudate, the dressing is not changed until the fifth postoperative day. Any fluid collection is evacuated by needle. Hyaluronidase (500 units) has proved useful in a few cases to help an undermined but not infected flap become adherent to its new bed.

The first sutures are removed on the tenth day, and the last sutures are left until at least the fourteenth day. The bolus is removed from the skin graft on the eighth or ninth day. If some of the graft has been lost, the wound is treated with compresses moistened with half-strength Dakin's solution or saline and reapplied every four hours for two or three days. Autogenous skin (saved at the time of operation and preserved in the skin bank) is applied and wet-dressed until it has become secure.

About one week after the wound is completely healed, i.e., usually about the third week after operation, passive range of motion exercises are started to limber up the hips and knees. When maximum flexion has been obtained, the patient is allowed to sit in his cushioned wheelchair for fifteen minutes twice on the first day. If no untoward reaction occurs, he is allowed to sit for thirty minutes twice the following day. The period of sitting is increased gradually so that by the end of a week the patient is usually able to sit for two or three hours at a time without danger of damage to the flap.

Flaps in other areas are treated somewhat less rigidly, depending upon their location. The general rule, however, in cases without complications is not to permit weight bearing or dependency for at least three weeks after operation.

Thick-split grafts of skin applied to granulating areas are perforated generously and sutured as sheet grafts. They are then covered

with coarse mesh gauze cemented around the margins of the wound with collodion. Saline dressings are changed every four hours, starting eight hours after operation. The grafts usually "take" in about five or six days, but weight bearing is not permitted on them for at least two more weeks, and not at all if the graft has merely been used as a temporary cover in preparation for reconstruction by flap. The coverage by pedicled flap is done as soon as the wound is completely healed.

COMMENTS

The results of the treatment of 600 decubitus ulcers in paraplegics over a five-year period have been analyzed in detail. Three hundred forty-seven ulcers have been operated upon, a total of 415 operations having been performed. Ulcers in the sacral, trochanteric and ischial areas have been the most common (71 per cent of the total) and have presented the greatest therapeutic challenge. This is in keeping with the findings of others who have reported on this subject. It is clear that the best results of treatment of ulcers in these locations have been obtained with surgery, and since spontaneous healing is uniformly very slow, there is no reason for delaying surgery past the time when the patient reaches reasonably good general condition and the ulcer is free of gross contamination and slough.

The best surgical procedures in our experience have included the following: (1) total excision of the ulcer and surrounding scar tissue, and of the underlying bursa and calcification of soft tissue when present; (2) radical removal of the underlying bone; (3) filling a deep hole so produced by means of a muscle flap; (4) coverage with a large pedicled flap of adjacent skin and fat; and (5) the use of a thick-split graft for coverage of the site from which the flap has been elevated or rotated. Often it is tempting to the surgeon to close such a donor wound by undercutting and suture. Follow-up data demonstrate that the thick-split graft is necessary for lasting relaxation of tissue. It should never be applied over another adjacent bony prominence. The purpose of removing the entire ulcer and all of the pathologic soft tissue is obvious: the infected tissue is ablated, the underlying bone responsible for the ulcer is exposed for removal, and the flap used for coverage of the wound can be sutured to relatively normal tissue rather than to infected, edematous scar tissue.

The importance of ostectomy has been amply shown by reports in the literature and by experience with this group of cases. This principle has accounted for a significant improvement in the results of surgery over the past few years. Since we know that squeezing the soft tissues between the bony prominence and the bed or chair is of paramount importance in the development of the ulcer, it follows that removal of the bone—and as much of it as possible—should result in a lowered incidence of recurrent ulcers. That this is true is shown by the increase in the incidence of healing (from 67 to 100 per cent) and the decrease in the incidence of recurrence (from 75 or 100 per cent to 3 per cent) in the ischial ulcers treated by progressively more radical ischiectomy. Recurrence of many ulcers in our early cases could be traced directly to the presence of a bony prominence which had been partly removed before, but had either been left sharp or rough or had become sharp and pointed again by irregular regeneration of the bone. We have not observed troublesome regeneration of bone in cases in which radical ostectomy has been done. This is a significant point. Care must be taken not to leave any sharp stumps. In dealing with ischial ulcers this involves carrying the ostectomy well up to the symphysis pubis and leaving a flat surface at the acetabular rim, on which the patient will sit.

In the case of trochanteric ulcers we have frequently found at the operating table that after removal of the trochanter there is a ridge of bone, fascia and scar tissue at the inferior edge of the ostectomy. This tissue must be removed by bevelling it off, if it is not to cause a recurrence of the ulcer. With sacral ulcers, we have, on occasion but not routinely, removed the entire posterior sacral table. Ordinarily a smooth surface can be obtained by chiselling off all the prominances including, in thin patients, the posterior superior iliac spines when they can be conveniently reached through the wound.

Whenever possible, the bony stumps should be covered with muscle or fascia. This provides an extra layer of protection. It is rarely possible to do this in sacral ulcers, but a rotation flap of fascia usually can be obtained for trochanteric wounds. A large hole (dead space) is made

by total ischiectomy, and if not filled with tissue, it will fill with blood, as evidenced by the high incidence of hematoma (twenty cases, or 24 per cent) in cases of ischiectomy and primary closure without a muscle flap. The best tissue to use, in our experience, is one of the hamstring muscles, usually the biceps femoris, which is divided low in the thigh, turned back on itself and sutured into the hole. It provides "fill," aids hemostasis, helps inhibit bone regeneration since it is interposed between and over the two stumps of the ischium and provides a good soft, well vascularized pad for sitting. There need be no qualms about sacrificing the biceps femoris since, in paralyzed patients, it is functionless.

Mulholland et al.,[39] Abramson[1] and others have shown conclusively that maintenance of nutrition is important for the prevention of ulcers. This is true of recurrent ulcers as well as primary ulcers. Also, squeezing of soft tissues between bed or chair and underlying bone, be it prominent or not, for prolonged periods of time can result in tissue necrosis and ulceration. Keeping these factors in mind, it is evident that careful as the surgery may be, ulcers can and do recur, especially after the patient leaves the hospital, and one must be ready to close them, with ample unscarred soft tissue.

It is for this reason that we stress the importance of *large* flaps of skin and fat. If an ulcer recurs, some of the flap is destroyed. If a small flap has been used, subsequent use of the remaining portion of the same flap is bound to result in the placement of scar over the site of the ulcer. If the flap is large, however, the surgical scar is placed far from the site of ulcer. If the ulcer recurs, the remaining unulcerated portion of the flap is abundant and can be used again without the danger of location of a scar in an area of trauma and previous ulceration.

The location of the base of the flap also is important, since it is desirable not only to assure good blood supply but also to place the surgical scar where it will not be subject to trauma and will not interfere with the formation of another flap to cover an ulcer that may develop later in a nearby location. For sacral ulcers, the flap should be based inferiorly and laterally so that the skin graft that is used to cover the donor area of the flap is placed over muscle, well away from the original ulcer, and so that if an ischial or trochanteric ulcer should develop later there will be no scar in the area to interfere with surgical closure.

For trochanteric ulcers, a rotation flap should be based inferiorly and laterally so that the skin graft and scar will be over the well padded anterior thigh, and the buttock and lateral and posterior thigh will therefore be unscarred.

Twenty-seven of our thirty-four ischial rotation flaps were based on the medial edge of the thigh. This technic had the disadvantage of placing a scar along the lateral side of the posterior thigh. However, no difficulty was experienced with healing, since there was no suture line in the area of the gluteal fold. Seven flaps were based laterally, with the suture line placed in a safe padded area over the medial aspect of the thigh. These are theoretically better because of the absence of scarring on the lateral side of the thigh, but in five of these cases a small wound separation and sinus developed at the edge of the flap in the area of the gluteal fold. Because of this high incidence of complications, which delayed healing appreciably, medially based flaps are favored. In most cases, a thick-split skin graft was used to cover the unsatisfied donor area of the flap. The importance of this technic is to reduce tension on the flap suture line. To demonstrate the need for this graft one need only adjust the operating table to put the thighs of the prone patient in right angle flexion, after the flap has been rotated over an ischial defect. This demonstrates the stress which is applied to the flap when the patient is in the sitting position.

By the use of these basic principles, the incidence of successful closure of sacral ulcers was increased to 84 per cent and the recurrence rate reduced to 11 per cent. In the case of trochanteric ulcers, success was achieved in 86 per cent and the recurrence rate was only 6 per cent. With ischial ulcers, successful closure was obtained in 97 per cent and the recurrence rate was only 3 per cent. These results are significantly better than those reported previously from this hospital and others.

Split skin graft coverage of large granulating sacral ulcers is advisable to obtain a closed wound before definitive closure with a rotation flap is attempted. However, grafts "take" poorly over ischial and trochanteric ulcers, and flap closure usually is carried out in the presence of an open wound.

Thick-split skin grafts were not used as definitive coverage of any of these ulcers. However, in a number of patients with sacral ulcers who refused further surgery, they held up for varying periods of time. Sixty-four per cent of these grafts broke down, and flap coverage was needed subsequently. It is important to remember that thick-split skin grafts from paraplegic patients should be taken from areas remote from the main operative wound and which will not be subject to trauma subsequently.

Ischiectomy with primary closure but without muscle flap or rotation flap was complicated by hematoma in a large number of cases and resulted in recurrence of the ulcer in 40 per cent of cases. Its use is reserved now for those patients in whom spasms would most certainly interfere with the healing of a flap but who, because of partial neurologic function, are not candidates for rhizotomy. If used, an effort should be made to fill in the dead space with a muscle flap rotated in from the gluteus maximus. Bilateral ischiectomy at one operation is ill-advised because of the high incidence of hematoma and the likelihood of cross infection.

Removal of one ischium may result in the breakdown of the soft tissues over the other ischium subsequently, and for this reason prophylactic ischiectomy of the other side is advised. However, patients usually are unwilling to have an operation when no ulcer exists. After bilateral ischiectomy, we have seen one coccygeal and two perineal ulcers, presumably because of pressure on these dependent areas in the absence of any other bony support. All three of these ulcers healed and have not recurred.

Ulcers in the less common sites are more easily treated. In general, the best results were obtained by excision of the ulcer and underlying bone with coverage by rotation flap.

The problem of the treatment of soft tissue calcification is still unsolved. Removal of this tissue is advisable when surgery is performed in the vicinity, and arthroplasty may be helpful in patients who have fused joints due to ectopic calcification of the soft tissues surrounding them. The best treatment seems to be prevention by the methods of physical rehabilitation (early exercises and ambulation). Secondary amyloidosis seems to develop more commonly in patients with large chronic ulcers than in patients with urinary tract infections alone. This is another argument for closure of the ulcers as soon as possible.

SUMMARY

1. An analysis is presented of the results of the treatment of 600 decubitus ulcers in 345 patients with paraplegia during a five-year period (1950 to 1955). Conclusions in this report are based on experience with these cases and an additional 400 decubitus ulcers reported on previously from this hospital. Sixty-five per cent of the patients had ulcers. One hundred fifty-eight ulcers were recurrent, that is, they had been closed, but then reopened. Ulcers occurred in nineteen different sites.

2. Surgery was the most satisfactory form of treatment. Three hundred forty-seven ulcers were treated surgically, a total of 415 operations being performed.

3. Ischial, sacral and trochanteric ulcers made up 71 per cent of the total number and presented the greatest therapeutic challenge.

4. The principles of surgical treatment found to be most successful were: (1) excision of the ulcer, surrounding scar, underlying bursa, and soft tissue calcification, if present; (2) radical removal of the underlying bone; (3) fascia or muscle flap to cover bone stumps and fill dead space; (4) coverage with a large regional pedicle flap of skin and fat; and (5) thick-split skin graft to cover the donor site of the flap.

5. Using this technic, the success of surgery, that is, the percentage of ulcers which healed and did not recur, was increased to 97 per cent for ischial ulcers, 86 per cent for trochanteric ulcers and 84 per cent for sacral ulcers. The recurrence rate following surgery was 3 per cent for ischial ulcers, 6 per cent for trochanteric ulcers and 11 per cent for sacral ulcers.

6. The pathology, general treatment, surgical treatment and the complications of decubitus ulcers in paraplegic patients are discussed.

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In hiatal hernia only the stomach, or part of it, is apt to lodge in the thorax. In post-traumatic diaphragmatic hernia other abdominal viscera also may be displaced into the thoracic cavity and the patient's symptoms will vary with the displaced organ or organs. Of course these patients often do have symptoms of disease of the gallbladder, stomach or heart, especially angina pectoris. It would be well, therefore, to rule out diaphragmatic hernia positively on patients with the foregoing symptoms when confirmation of the tentative diagnosis is unavailable. (*Richard A. Leonardo, M.D.*)

A Modification of the Davis and Traut Skin Graft

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To diminish the danger of loss of split-skin grafts due to extreme drainage, a modification of the perforating method of skin grafting advised by Davis and Traut[1] is presented.

A number of triangular-shaped split grafts are used, with a base measuring approximately 1½ inches, arranged in a pattern as required to cover a healthy granulating wound surface.

With such triangles not only is adequate drainage secured for exudation by means of the radial, respectively oblique channels, but also the technic of graft-cutting is simplified, especially if a Padgett dermatome is not available.

The grafts which should include the epithelial layer and the tips of the papillae of the corium are cut by the technic of Ollier[2] and Thiersch[3] between sterile boards in the hands of an assistant. Using the scalpel as the center or axis point, such small grafts can easily be obtained by cutting in a semi-circular direction. This makes the use of a dermatome or specially made knives unnecessary.

The grafts then are placed upon the granulating areas in such arrangement that in round defects the pieces of the grafts touch each other while the bases rest at the periphery. For square defects, an interchangeable pattern of axis point to base will cover the area in adequate fashion.

Overlapping of the graft margins should be avoided and small narrow interspaces should be kept in between to provide small drainage channels, so enabling the grafts to remain pressed firmly to the granulations of the defect. Vaseline gauze and pressure dressings are applied and left unchanged for a period of ten days.

CASE REPORTS

CASE I. A sixty-two year old woman with a varicose ulcer of her right lower extremity was treated with the method described herein.

Vein ligation had been performed on the patient in 1947. The ulcer persisted for six years; it was located at the lateral aspect of the lower third of the patient's right tibia and measured 3½ inches in diameter.

After twenty-two days of conservative care (elevation, saline packs, antibiotics, high caloric–high protein diet, high doses of vitamins B and C), a skin graft was applied by the use of the previously described modification of the Davis and Traut skin graft using five triangular-shaped split-skin grafts.

On the tenth postoperative day, when the dressing was removed the grafts were found to have taken fully, forming a smooth covering of the former defect.

CASE II. This patient was a two year old child who was treated in the same manner as Case I. The child had an area of third degree burn, measuring 3 inches in length and 2 inches in width, within a healing area of a second degree burn at the right anterior chest wall (burn caused by boiling broth).

On the fifteenth day after the injury was sustained a modified Davis and Traut skin-grafting procedure was performed using four triangular-shaped grafts in longitudinal pattern. On removal of the dressing on the tenth postoperative day the grafts had taken fully, covering the defect of skin.

SUMMARY

A modification of the Davis and Traut perforating skin graft has been presented.

Modification of Davis and Traut Skin Graft

The advantages of this modification are as follows: (1) Drainage of secretion is secured. (2) A dermatome or special knives are not essential. (3) The donor areas are smaller and are epithelized faster.

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Hamilton and co-workers compared postoperative results on fifty-six patients with duodenal ulcer treated by vagotomy with emptying procedure (pyloroplasty or gastroenterostomy) and an equal number of patients with duodenal ulcer who were subjected to subtotal gastrectomy. They found equally good results but believe that vagotomy has the advantage of being safer; the stomach is left and it is possible to perform conservative gastrectomy if the duodenal ulcer recurs. (*Richard A. Leonardo, M.D.*)

A Hemostatic Suture for Gastrojejunal Anastomosis

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We believe that the suture to be described herein is an original suture. Thorough search of the literature has failed to reveal a similar principle. Any continuous suture used for gastrojejunal anastomosis with clamps must fulfill the following four requirements: (1) The suture must be hemostatic. (2) There must be a minimal diaphragm of sutured tissue. (3) There must be a minimum of tension. (4) There must be no purse-string effect.

We believe the suture to be described fulfills all these requirements and is more hemostatic than any of its predecessors.

Beginning with the recommendation of the "glover's suture" or "furrier's suture" by Guglielmo di Salicetti[1] in the thirteenth century, a myriad of methods of suturing stomach and bowel has been recommended. The following names are most prominent in this evolution and many of the sutures as used today bear the name of the originator[2] (Lembert, Dupuytren, Wysler, Czerny, Albert, Gély, Appolito, Halsted, Gould, Cushing,[3] Maunsell, Connell,[4] Jobert, Heister and Bell). It is not within the scope of this presentation to review these sutures.

Beginning in November, 1945, a conventional gastrojejunostomy was employed by us, with the result that five of the first forty-nine patients undergoing the procedure bled postoperatively, three severely enough to require a second intervention. On this basis, investigation was undertaken with a view toward developing a more completely hemostatic suture which still fulfilled the cardinal requirements of satisfaction as outlined previously. The new suture has been used since the middle of 1946 in 407 gastrojejunostomies, with only three instances of postoperative bleeding, none sufficiently severe to warrant a second intervention. There have been no deaths from hemorrhage. The 407 gastrojejunostomies were divided into two groups. The first group consisted of 198 gastrojejunostomies with vagotomy. The second group was made up of 209 gastrojejunostomies with gastric resection. We have used the suture in both groups exclusively.

TECHNIC

The suture to be described concerns only the inner through and through layer of the anastomosis and bears no relationship to the type of seromuscular suture used. As a matter of interest, we have used fine silk Halsted interrupted mattress sutures for this layer as well as to buttress the corners. The inner through and through layer has been No. 00 chromic catgut with a curved atraumatic® needle. The basic principle is that of a continuous locked suture with a superficial unlocked suture alternated between each lock which bisects the length of the locked suture.

The hemostatic suture is begun (Fig. 1) at the side of the anastomosis opposite the operator by inserting a conventional inverted U-corner stitch. This is tied and held with a curved hemostat, the seromuscular suture having been held with a straight hemostat for purposes of differentiation. The first and all subsequent locked bites are 4 to 5 mm. in length and the same distance from the cut edge of the stomach and bowel. The locked suture is set firmly and

Fig. 1. The three-bladed clamp has already been applied; the posterior seromuscular sutures have been applied and the through and through inner suture layer is to be begun. A, the inverted U angle stitch has been tied and held, and the first locked stitch is begun. B, the first locked stitch in place with tension toward the surgeon. C, application of the first bisecting stitch, tension still toward the surgeon. D, locked stitch and bisecting stitch in place. Beginning second locked stitch, tension toward assistant. E, second posterior row completed; U stitch placed at angle. F, beginning locked stitch first anterior row, tension toward surgeon. G, first locked stitch in place, tension toward assistant. H, first bisecting stitch applied in anterior row, tension toward assistant. I, first anterior row completed; second anterior row being applied, in this case a continuous Cushing type of suture.

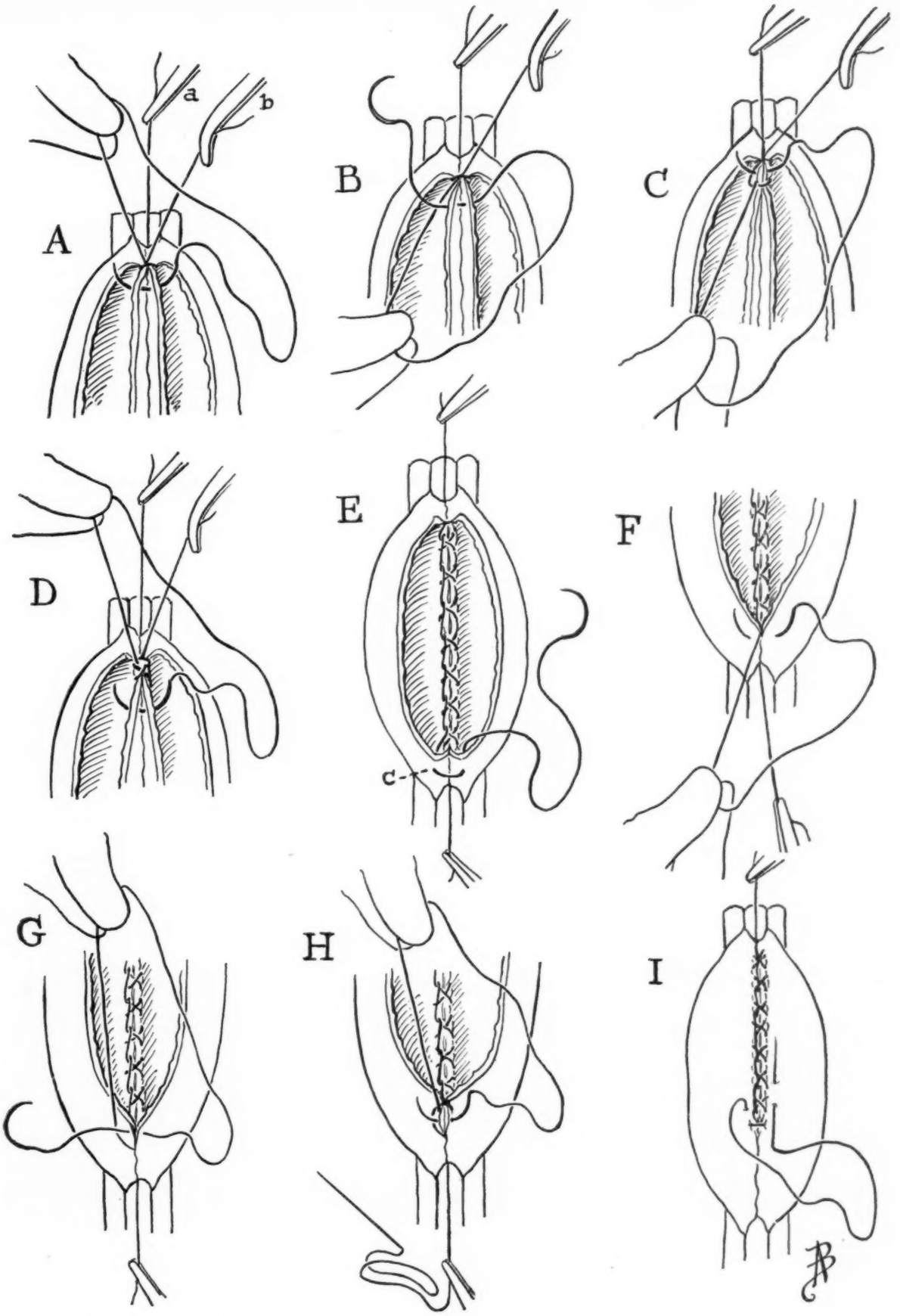

FIG. 1.

tension is maintained while a through and through suture is taken in the middle of the locked stitch and superficial to it. Another locked suture is then taken, followed by the plain suture through its middle. These are alternated the full width of the anastomosis on the posterior wall. The *sine qua non* of the suture lies in the fact that while the locked sutures are being applied tension is maintained in the direction of the assistant, whereas in pulling up the locked sutures and maintaining tension while bisecting sutures are applied the pull is firmly in the direction of and by the surgeon himself. This is well shown in Figure 1. When the near corner is reached, the posterior row is finished with a locked suture and the needle is passed from within outward on the stomach side and from without inward on the bowel side before the alternating locked and unlocked sutures are begun anteriorly. These are continuous to the point of origin and the last stitch again should be locked and tied to the free end of the suture. Inversion anteriorly may then be carried out by any means preferred, in the illustration a continuous Cushing type of suture. The corners are buttressed with silk and the anastomosis is complete.

SUMMARY

A new hemostatic gastrojejunal suture technic is presented. This suture fulfills all the other requirements of a good gastrointestinal suture. It has been used in 407 cases with no deaths from hemorrhage and, as yet, no secondary interventions for hemorrhage.

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An Improved Method for Handling Ureteral Catheter Drainage

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Rather frequently it becomes necessary for a urologist to leave a ureteral catheter *in situ* for drainage of a kidney pelvis after it has been placed there, sometimes with considerable difficulty, through cystoscopic manipulation. Maintaining this ureteral catheter in position and providing a satisfactory method of collecting the urine from it has always presented a problem to the patient, to the doctor and to the nurse. In the past, various ingenious methods have been tried. The specimen bottle with the perforated milk bottle cap, which the patient carefully balanced between his legs until he went to sleep and then tipped the whole thing over, was definitely not popular with the nursing staff. Again, a male urinal could be maintained between the legs but this necessitated the patient staying awake and always lying flat on his back. At other times a rather large piece of rubber tubing with a glass adapter tip has been taped to the patient's leg and the ureteral catheter inserted into the glass tip and maintained with adhesive. I have never seen one of these which did not leak a

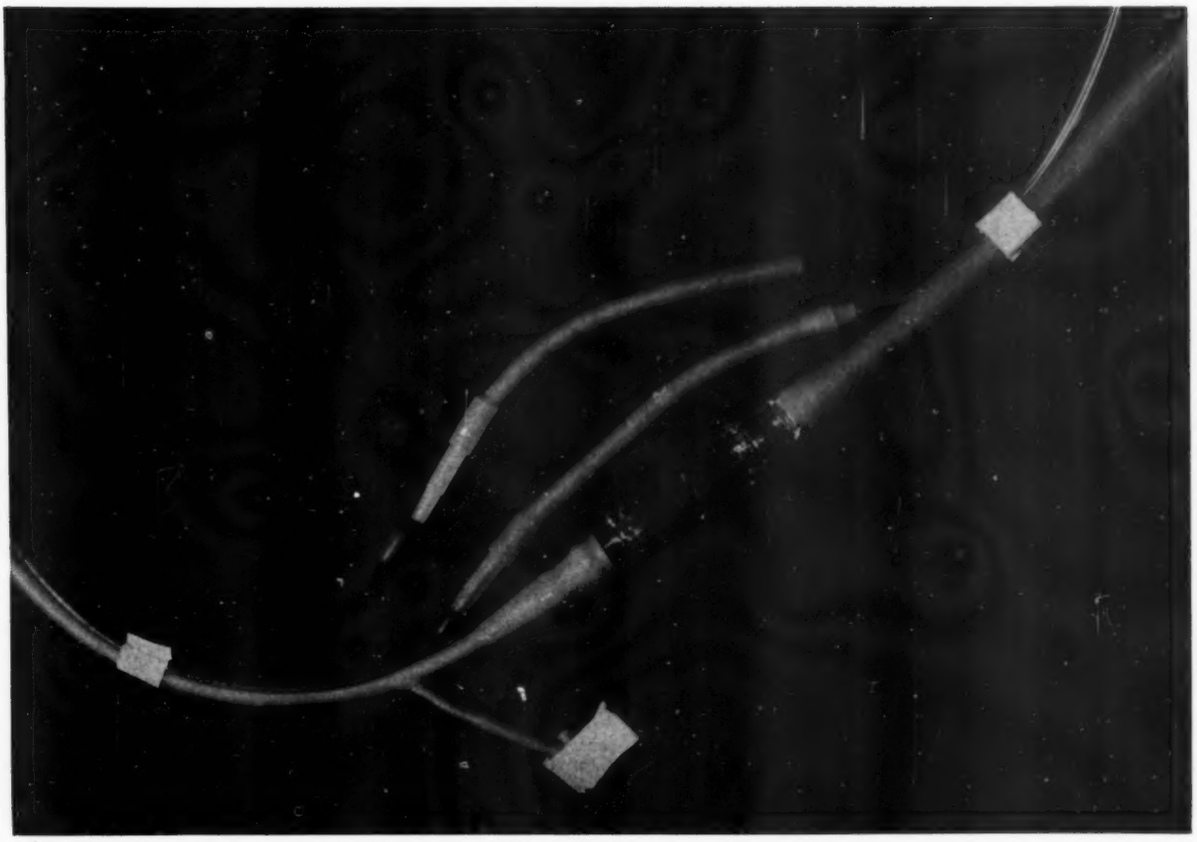

Fig. 1. Foley catheter and ureteral catheter are shown to the left. The tubes to right lead to drain bottle. The disassembled rubber cystoscopic tip, plastic adapter and drain tube are shown above the completely assembled connected and taped tubes.

great deal of urine around the taped junction of the catheter and the glass connecting tip, necessitating frequent bed changing.

Recently, Menville[1] called attention to the use of polyethylene plastic tubing which comes with the standard set for administering intravenous fluids. He noted that one end of the tubing had been molded to fit into the standard Luer needle hub. He recommended using a needle of the proper caliber to insert into the free end of the ureteral catheter and then connecting the hub of the needle onto the adapter of the intravenous tubing. This procedure certainly must be very satisfactory to control the disposal of urine. However, we have found that occasionally small bits of pus or blood, which pass down the lumen of the ureteral catheter, will become blocked at the lumen of the needle which is considerably smaller than the lumen of the catheter.

For several years we have used the discarded intravenous tubing as suggested by Menville but have made our connection with the ureteral catheter by using one of the small, perforated rubber adapter tips which fasten over the end of the cystoscope and through which the ureteral catheters pass down the cystoscope. These rubber adapters will fit over the plastic end of the tubing which was made to fit into the Leur needle hub. The end of the catheter is then inserted through this rubber adapter tip and passed for a considerable distance into the polyethylene tubing. The end of the tubing is then led over the side of the bed into a proper receptacle.

The problem of stabilizing and maintaining the ureteral catheter in its proper position has always been one which has given some concern. To do this, at the time of cystoscopy we insert a No. 18 F. Foley catheter with a 5 cc. balloon inflated to about 10 cc. The ureteral catheter is then pulled down and checked by x-ray to determine its position in the kidney pelvis. The ureteral catheter and the Foley catheter are then taped together for stability and the polyethylene tube and the drainage tube from the Foley catheter are taped together in two or more places to maintain stability and to keep the polyethylene tubing and the ureteral catheter from becoming separated. The tubes may be led into the same or separate bottles.

We have used this method for a number of years, and the longer we use it the more pleased we and the nursing staff are with the ease with which patients can be treated. If one has qualms about the sterility of intravenous tubing which has been used, a new one can easily be obtained from central supply because it is not expensive. Figure 1 shows the set-up admirably.

REFERENCE

1. Menville, J. G. Disposable polyethylene tubing for ureteral catheter drainage. *J. A. M. A.*, 156: 1104, 1954.

New Suture or Ligature Ampul

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THE inconvenience and even occasional superficial laceration encountered in the common method of breaking open ligature or suture ampuls and then rewinding them on a spool of rubber or other material has prompted me to seek a simpler device. Figure 1 demonstrates a new type ampul from which the material is easily withdrawn as needed through a slotted leakproof plastic fitting. The thread becomes available immediately after the vial is uncapped. The thread is so wound inside the ampul that it does not tangle as it is withdrawn.

The customary antiseptic solutions may be used inside the vial and within the cap; the stopper and cap are not affected by these solutions. The whole ampul may be placed in a jar containing the usual germicidal solution.

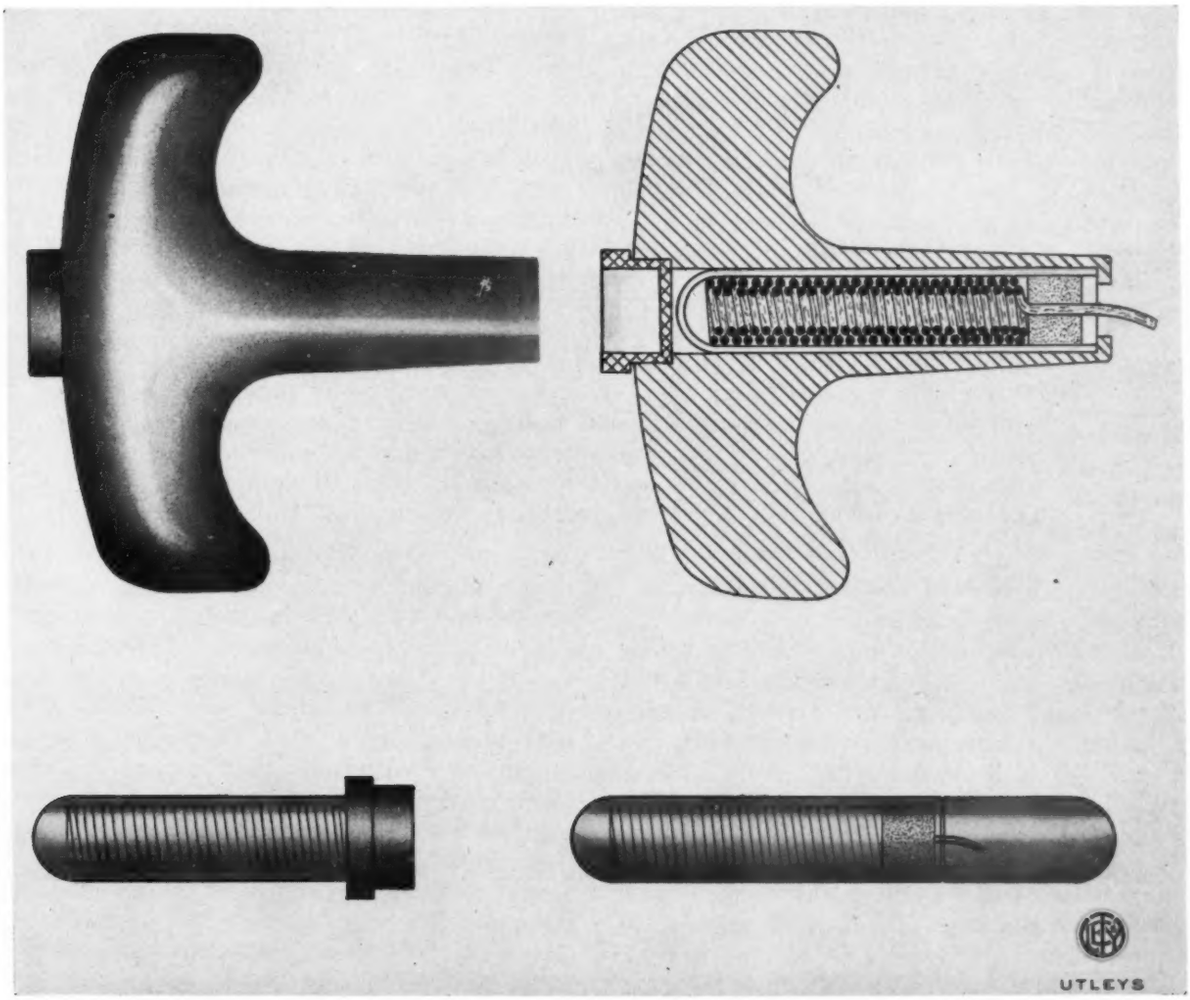

FIG. 1. Upper left hand corner: plastic ampul holder with cap. Upper right hand corner: loaded ampul within holder and end of thread ready for use. Lower left hand corner: Loaded ampul with cap sealed. Lower right hand corner: loaded glass ampul.

It is then immediately available for use. The ampul may be made of glass or inert plastic material and its inside may be dry as is commonly the case with silk and cotton sutures and ligatures. Swaged-on needles may be employed with the thread. In this case the needle first exits through the stopper. If glass is used for the ampul, a special easy hand-fitting plastic or metal holder is provided to prevent any accidental breakage of glass in the wound.

SILBERT and Haimovici studied almost 500 amputations performed for ischemic gangrene and reached the conclusion that careful study of local conditions is absolutely essential before the surgeon can decide the optimal site of conservative amputation. If possible, amputation should involve only a toe or be a mid-tarsal operation, since under these conditions no prosthesis is required. If one must go higher, a supramalleolar site or a mid-leg site have many advantages over a mid-thigh amputation since postoperative pain is less and the prosthesis seems to work better. The authors found that it is rarely necessary to amputate through the thigh. (*Richard A. Leonardo, M.D.*)

CASE REPORTS

Hemangiopericytoma

REVIEW OF ABDOMINAL CASES

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THE hemangiopericytoma was described in 1942 by Stout and Murray[13] who differentiated it from the glomus tumor and other vascular tumors. This is a tumor of the pericytes, a modified smooth muscle cell regulating the capillary lumens described by Zimmerman[19] in 1923. Hemangiopericytomas are composed of capillary blood vessels with one or more layers of rounded cells about them identified as pericytes by Stout and Murray.[13] These tumors lack the organoid structure and axis cylinders of the glomus tumor, and are differentiated from hemangioendotheliomas by the orderly growth of the endothelium which does not grow into the lumen or invade the vessel wall.

Since the original description by Stout and Murray,[13] Stout[16] has collected 207 cases as of December 31, 1954, of which fifty-nine have been reported. The earlier cases reported were subcutaneous tumors for the most part. However, his following breakdown of the material shows a widespread distribution: thyroid, one; orbit, five; eye, one; meninges, three; brain, one; stomach, eight; intestines, four; retroperitoneum, mesentery and omentum, twenty-one; oral cavity and pharynx, six; liver, three; salivary glands, two; mediastinum, five; larynx and trachea, three; pleura, one; lung, one; nasal cavity and sinuses, two; uterus, sixteen; female breast, two; male breast, one; ovary, one; vulva and vagina, three; prostate, two; hands, twelve; arm and forearm, ten; feet, four; leg, thigh and gluteal region, forty-six; back, nine; chest and abdominal wall, ten; neck, seven; face, seven; scalp and ears, five; and bones, five. An increasing number of these tumors are being encountered within the abdominal cavity, exclusive of the uterus, occurring in the retroperitoneum, mesentery, omentum or wall of the gastrointestinal tract. The difficulties encountered in the management of this group of tumors and the high incidence of malignancy has prompted this review of the fourteen documented cases in the literature and report of an additional case involving the rectum.

CASE REPORT

The patient, a fifty year old single white woman, was admitted to the University Hospital on June 22, 1953, for treatment of rheumatoid arthritis of two years' duration involving both knees. Six months before admission intermittent chills and spiking temperatures had developed.

Physical examination showed a chronically ill woman with diffuse swelling of both knee joints and limitation of motion. The heart, lungs and abdomen were normal. The blood pressure was 110 mm. Hg systolic, and 70 mm. Hg diastolic. Rectal examination disclosed a movable, discrete, spherical mass, 5 cm. in diameter, beneath the mucosa on the right lateral wall 10 cm. from the anus. The mass could be felt through the posterior fornix on vaginal examination and did not appear to be related to the uterus or adnexae which were normal in size and location. Sigmoidoscopy revealed a spherical bulge beneath the mucosa. Proctoscopy under caudal anesthesia demonstrated that the mass was outside the rectal wall inasmuch as it could not be felt at the anus

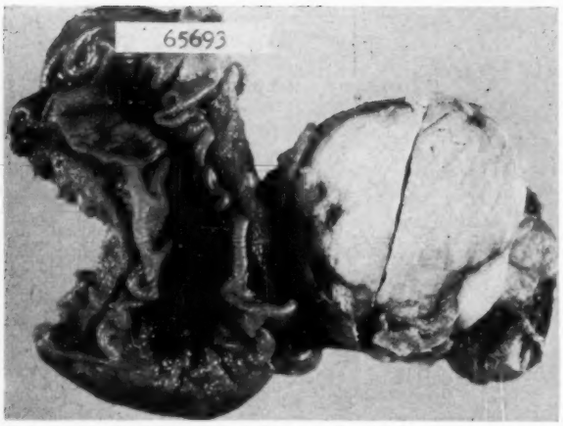

FIG. 1. Gross specimen of tumor and adherent rectum.

when the overlying mucosa was pulled down with a Babcock clamp. Removal of a biopsy specimen was not attempted. Urinalysis was negative. The hemoglobin was 9.2 gm., red blood cells 3.62 million, white cells 11,000 with 70 per cent polymorphonuclears, 25 per cent lymphocytes, 2 per cent eosinophils, 1 per cent basophils, and 2 per cent monocytes. The blood was negative for brucella and cold agglutinins. The Widal and Weil-Felix tests were negative. Blood, stool and urine cultures were negative and the stool was negative for ova and parasites. The Mazzini test was also negative. Erythrocyte sedimentation rate was 126 mm./hour. The total proteins were 7 gm. per 100 cc. of blood with an albumin of 4.2 gm. and globulin of 2.8 gm. The serum bilirubin was 0.2 mg. per cent and there was 9.0 per cent bromsulphalein® retention in forty-five minutes. Sternal marrow aspiration showed slight granulocytic hyperplasia. Roentgenographic examination of the chest and gastrointestinal series were normal. Cholecystogram was normal.

The arthritis and pyrexia quickly improved with cortisone and penicillin therapy. Transfusions were administered and the gastrointestinal tract was prepared for removal of the retrorectal tumor. At operation performed by one of us (L. R. S.) on July 23, 1953, the abdomen was entered through a Cherney incision and a globular tumor, 6 cm. in diameter, was found on the right side of the rectum just beneath the peritoneal reflection. This was freely movable except on its medial surface where it appeared to be adherent to the rectal wall. There were no enlarged lymph nodes encountered and the remaining abdominal viscera were normal. The tumor with its overlying peritoneum and the rectum were mobilized from the hollow of the sacrum and the right pelvic wall. Because the tumor was attached to the rectum and was of an uncertain nature, it was removed *en bloc* with a 10 cm. segment of rectum and lower sigmoid. End-to-end anastomosis was performed between the sigmoid and rectal stump using two layers of interrupted cotton sutures, and the abdomen was closed without drainage.

Postoperative convalescence was uneventful. Cortisone was continued until discharge on the fourteenth postoperative day. The improvement in the arthritis permitted resumption of her teaching six months later. Examination on January 19, 1955, eighteen months after operation, revealed a well healed anastomosis and no evidence of recurrent tumor.

Examination of the specimen (Fig. 1) showed a segment of large bowel with a nodular tumor mass 4.5 by 3.0 by 3.5 cm. in the mesocolon. On cross section the tumor appeared irregularly nodular but was contained within a capsule of fibrofatty tissue. On section, the tumor was of grayish pink color and of a soft rubbery consistency. Microscopic sections stained with hematoxylin and eosin showed a tumor consisting of thin-walled blood vessels of endothelium and a layer of collagen. Surrounding the vessels were densely packed elongated or spindle-shaped cells with large oval or elongated nuclei and an inconspicuous faintly acidophilic cytoplasm and occasional sheets of fibrillar material between them. These cells filled the spaces between the vessels and appeared to be related to them. An occasional mitosis was seen in these cells. In some areas there were multinucleated giant cells with about twenty dark-staining basophilic nuclei clustered in their centers. (Fig. 2.) The Laidlaw stain for reticulum showed abundant vascularity, and many collapsed capillary vessels were recognizable which could not be identified in the hematoxylin and eosin sections. (Fig. 3.) The cell aggregates were seen to be outside the vessel walls. The trichrome stain showed that the fibrillary material was staining blue, thereby identifying it as collagen. The phosphotungstic acid hematoxylin stain showed nothing additional.

REVIEW OF ABDOMINAL CASES AND COMMENTS

This is the fifteenth case of hemangiopericytoma reported within the abdominal

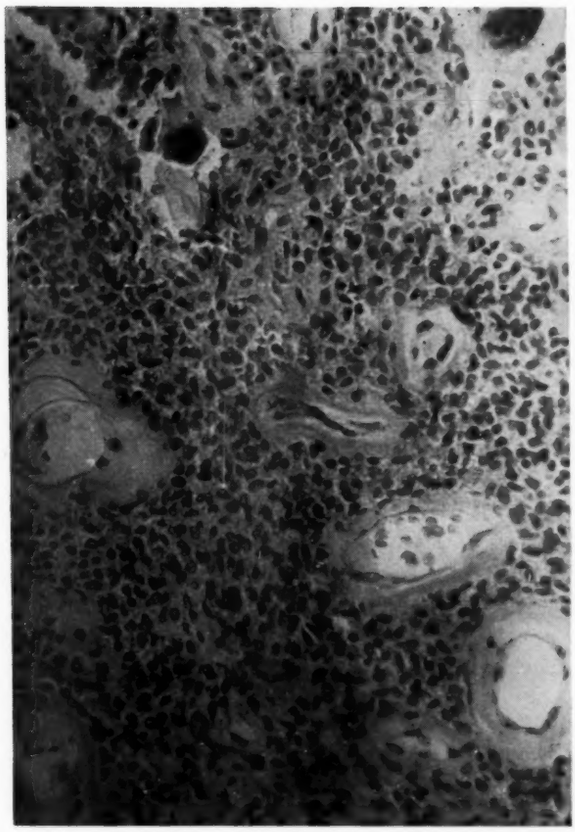

FIG. 2. Section of tumor showing collagenous sheaths and pericytes about capillaries, and multinucleated giant cell formation.

FIG. 3. Laidlaw stain for reticulum demonstrating many collapsed capillaries not visualized in hematoxylin and eosin sections.

cavity, exclusive of those occurring within the uterus.[7,11] The latter are not considered herein inasmuch as the general use of total hysterectomy for uterine tumors adequately removes hemangiopericytomas in most instances. Table 1 summarizes the clinical data on the abdominal cases reported in the literature. This indicates the occurrence among all age groups and the even sex distribution noted in previous reports. The descriptions indicate that the origin of most of these tumors is in the areolar tissues of the mesenteries, omentum, retroperitoneal space or intestinal wall. However, the tumor reported by Thompson[17] was a pedunculated polyp arising from the submucosa of the jejunum. Pack and Tabah[10] reported a lesion arising in the left psoas muscle growing forward into the abdominal cavity. The tumors reported by Bacon et al.,[3] Forman and Campbell,[6] and ourselves have arisen in the areolar tissues about the rectosigmoid just beneath the peritoneal reflection. Reviews[4,8] of retrorectal and presacral tumors have not reported hemangiopericytomas in this region.

The gross appearance of hemangiopericytomas has varied with their vascularity. Some have been of a red color with a soft, friable, cystic consistency, while others have had a yellowish white color with a firm fibrous consistency, as demonstrated by our case. Calcification occurred in the tumor reported by Pack and Tabah,[10] leading to a preoperative diagnosis of osteogenic sarcoma. The tumor between the right kidney and adrenal reported by Ackerman[1] also showed calcification. The blood supply of some tumors has been abundant and has constituted a technical problem in some instances, as pointed out by Ault,[2] Forman and Campbell,[6] and Wise.[18] Encapsulation has been complete, partial or entirely absent. In the case reported herein, the tumor demonstrated the free mobility consistent with complete encapsulation, but was fixed at one

TABLE I
SUMMARY OF CLINICAL DATA

Author	Sex and Age (yr.) of Patient	Symptoms and Findings	Location	Size or Weight	Treatment	Result
Ackerman[1]	M, 68	Pain, constipation, mass	Between right kidney and adrenal	1,020 gr.	Excision	Recurrence; metastases to right lung; death in 18 mo.
Ault et al.[2]	F, 34	Abdominal cramps, melena	Mesenteric border of sigmoid	3.5 by 2.5 cm.	Resection of sigmoid	Recurrence in 34 mo.; reoperation; patient living and well 5 yr. postoperatively
Bacon et al.[3]	M, 56	Extrarectal mass	Retrorectal space	4 cm.	Excision	Too recent to state
Forman and Campbell[6]	F, 40	Abdominal pains, retrorectal mass	Pelvic retroperitoneum	5 cm.	Excision	Recurrence, invading rectum in 11 mo.
Melicow[9]	F, 11	Not stated	Retroperitoneum	Not stated	Excised	Recurrence; metastases to skull and pelvis
Pack and Tabah[10]	F, 20	Abdominal mass	Left psoas muscle invading vertebra	15 by 10 by 10 cm.	Excision and radiation	Well 1 yr. later
Slattery et al.	F, 50	Pelvic tumor	Retrorectal tissues	4.5 by 3 by 3.5 cm.	Anterior resection of rectum and tumor	Well 18 mo. postoperatively
Smith and Swenson[12]	F, 43	Abdominal cramps and mass	Ileum	10 by 12 cm.	Excision	Too recent to state
Stout and Cassel[14]	M, 92	Abdominal mass, duration 60 yr.	Omentum	12 by 9 by 8 cm.	None	Found at autopsy
Stout[15]	F, 81	Loss of weight, melena, mass	Mesojejunum, with peritoneal implants	8 by 6 by 4 cm.	Excision	Death in 4 mo.
Stout[15]	F, 47	Pain and pelvic mass	Pelvis near uterus and left ureter	8.5 by 7.8 by 6.7 cm	Excision and radiation	Not reported
Stout[15]	M, 11	Mass, left lower quadrant	Left iliac fossa	.....	Biopsy and radiation	Generalized metastases and death in 9 yr.
Stout[18]	M, 59	Colicky pain	Ileum, with metastases to mesenteric nodes	4 by 1.5 cm.	Resection of ileum and mesentery	Died from metastases to liver in 18 mo.
Thompson[17]	M, 36	Cramps, vomiting, distention	Pedunculated polyp in jejunum	4 by 2.5 by 2 cm.	Excised	Too recent to state
Wise[18]	M, 43	Abdominal mass	Pelvis and lower abdomen	20 by 11 by 10.5 cm.	Biopsy and radiation; excision 5 yr. later	Died from metastases in 6 mo.

point to the rectal wall. This finding was also reported by Bacon et al.[3] and is apparent in the operative descriptions of other cases.

An abdominal or pelvic mass has been the principal symptom and physical finding. Pain in the area of the tumor and vague gastrointestinal symptoms have been common. The tumor reported by Stout[15] in the mesojejunum was accompanied by melena although the mechanism is not clear. The patient reported by Ault et al.[2] complained of melena secondary to ulceration into the sigmoid of a hemangiopericytoma arising in the muscularis at the mesenteric border. The tumors of the small bowel reported by Stout[15] and Smith and Swenson[12] had symptoms of incomplete small bowel obstruction. The lesion reported by Thompson[17] occurring as a pedunculated polyp of the jejunum produced an acute intussusception. The large tumors reported caused relatively few pressure symptoms, as indicated by Wise[18] in his report of a case in which the tumor filled the entire pelvis, and Stout and Cassel[14] who reported a hemangiopericytoma

of the omentum of sixty years' known duration found at autopsy in a ninety-two year old man.

Diagnosis has been made by microscopic examination only. None of the cases reported indicate that diagnosis has been made at the time of operation by frozen section. Exact diagnosis may depend upon special staining methods, as Stout[15] and Stout and Murray[13] have demonstrated. These authors have further pointed out that the histologic appearance of these tumors does not indicate whether they are benign or malignant.

Until recently some hemangiopericytomas may have been unrecognized as Pedowitz et al.[11] have shown by a resurvey of their uterine sarcomas which proved 10 per cent of these tumors to be hemangiopericytomas. Fergeson et al.[5] have suggested that the glomus tumors reported which do not contain nerve fibers may be hemangiopericytomas. These workers also believe that most of the glomus tumors described as arising from regions of the body distant from the subcutaneous tissue are probably hemangiopericytomas.

Although Stout[16] has found 21 per cent of all hemangiopericytomas to be malignant, nine or more than half of the extrauterine abdominal group of tumors have been malignant. This has been demonstrated by direct extension of tumor tissue to adjacent structures, recurrence after excision, and also metastases to regional lymph nodes, the liver, lungs and bone. Locally invasive lesions have run a long course and attained large size, while those with distant metastases have been fatal within eighteen months. The enucleation of seemingly localized, encapsulated tumors has been followed by local recurrence and distant metastases.[1,6]

Surgical excision has been the treatment in all instances except the case reported by Stout[15] in which biopsy and radiation were employed, and the case of Stout and Cassel[14] (previously cited) in which the patient carried a known tumor for sixty years without treatment. Excision has varied from enucleation to wide resection of the growth with adjacent structures. The apparent encapsulation has invited enucleation. However, the prompt recurrence of some tumors and the high incidence of malignancy suggests the advisability of wide removal if a hemangiopericytoma is suspected. The large tumor between the right adrenal and right kidney reported by Ackerman[1] appeared well encapsulated and was enucleated, only to recur locally and metastasize to the lungs causing death within fourteen months. In the case of Forman and Campbell,[6] there was recurrence in the rectal wall eleven months after enucleation, necessitating subsequent resection of the bowel. In reporting a polypoid lesion of the jejunum treated by simple excision of the polyp, Thompson[17] suggests that resection of the segment of bowel would have been preferable. The segment of bowel adjacent to tumor and adjacent lymph node-bearing tissues were removed in our case because of slight adherence to the rectal wall and the uncertain nature of the tumor.

Radiation therapy has seemed helpful in three of four cases in which it has been used. Stout[15] reports a non-resectable lesion of the left iliac fossa controlled by radiation for nine years after laparotomy had been performed and a biopsy specimen had been taken. The incompletely removed tumor reported by Pack and Tabah[10] has apparently been controlled for one year by postoperative radiation. The extensive pelvic tumor reported by Wise[18] may also have been controlled for a five-year interval although excision was ultimately necessary and was followed by fatal metastases within six months. Follow-up information is not available on the fourth patient reported by Stout;[15] this patient received radiation following excision of the pelvic tumor adjacent to the uterus and left ureter.

SUMMARY AND CONCLUSIONS

A case of hemangiopericytoma arising in the retrorectal areolar tissues at the peritoneal reflection has been reported. This is the fifteenth extrauterine tumor of this type encountered within the abdominal cavity. Review of the other hemangiopericytomas of this group shows a higher incidence of malignancy than similar tumors in other locations, and suggests the advisability of wide excision despite the apparent encapsulation often present. Recent reports suggest more frequent occurrence than the small number of cases indicates. The possibility of this tumor should be considered in tumors of the retroperitoneum, omentum, mesentery and gastrointestinal tract.

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So-called "benign" giant cell tumors of bone are not always as benign as their name would indicate. Haas and Ritter have recently reported one such case in which this tumor, situated in the upper end of the femur, was "completely removed" by local excision. Two and a half years later the patient returned with metastasis to the prepuce. (*Richard A. Leonardo, M.D.*)

Intrafollicular Ovarian Pregnancy

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The incidence of ectopic pregnancy in the ovary has been a controversial subject throughout the medical literature. Many famous investigators have stated that such ovarian implantation is not as rare as it would seem to be from the relatively small number of reported cases, and that the majority are either overlooked or unreported. The earliest suggestion of the possibility of an ovarian pregnancy was made by Mercerus[1] in 1614. The first apparently authentic case was described by Kawer[2] in 1897. However, the first accurate clinical and histologic study of an intrafollicular ovarian pregnancy was reported by van Tussenbroek[3] in 1899. Since that time many cases have been described and a great deal of discussion raised as to whether these were true ovarian pregnancies, or merely secondary implantations upon the ovary of a ruptured tubal or abdominal pregnancy.

In 1932 Wollner[4] reviewed the entire literature on ovarian pregnancy published up to that time. Of the eighty-seven possible cases of this condition, he accepted only forty-eight as authentic ovarian pregnancies. Courtiss[5] was able to find an additional forty cases which were reported during the subsequent ten years (1932 to 1943). It is evident that great controversy exists as to even the true number of primary ovarian pregnancies, since the authentic cases have been variously calculated as sixty (Curtis[6]); fifty-two (Novak[8]) and eighty-four (Preston[9]). Using Wollner's and Courtiss' undeniable cases as a basis, we have reviewed the entire American, German, French and Scandinavian literature from 1942 to 1953. From this review we have concluded that although hundreds of cases are reported, we have been able to prove only 154 cases of true primary ovarian pregnancy from the description of the published case histories. The remainder which were reviewed were believed to be merely secondary implantation of the ectopic gestation upon the surface of the ovary. The case reported herein brings the total number of irrefutable cases to 155.

Added to this understandable confusion is the fact that many cases remain unrecognized either because of poor pathologic technic, loss of extirpated specimens or paucity of pathologic material. Forssner[10] has suggested that many cases of intra-abdominal hemorrhage arising from the ovary which necessitated laparotomy were actually masked early ovarian pregnancies. As an example of this he reports one case in which on serial sectioning of an ovary removed for profuse follicular bleeding, a single chorionic villus was found in the corpus luteum, thus indubitably proving the presence of an ovarian gestation. Titus[11] is also quoted as saying that many chocolate cysts of the ovary were in reality ovarian pregnancies, but could not be recognized as such because of early rupture of the sac or because of degenerative changes occurring in the pregnancy.

Much of the confusion among the reported cases apparently has resulted from the lack of strict interpretation of what constitutes a true ovarian pregnancy.

Criteria for such a definition were first established by Hueppe,[12] Worth[13] and Possi[14] who based their standards upon purely anatomic terminology. However, it remained for Cohnstein[15] in 1877, Spiegelberg[16] in 1878 and Norris[17] in 1909 to formulate the individual conditions which today are accepted as essential. These may be outlined briefly as follows: (1) The tube, including the fimbria ovarica, should be intact and the former be clearly separated from the ovary; (2) the gestation sac should definitely occupy the normal position of the ovary; (3) the sac should be connected to the uterus by the ovarian ligament; and (4) unquestionable ovarian tissue should be demonstrated in the wall of the sac.

To these definitive rules Williams[18] has added: "that unquestionable ovarian tissue must be found at several places in the wall of the sac at some distance from each other."

He believed that this requirement was necessary because in certain cases of tubal or broad ligament pregnancy the ovary may be flattened out and to a certain extent incorporated into the sac wall. Furthermore Miller[19] believes that besides the aforementioned, the real major condition necessary for the diagnosis of an intrafollicular ovarian pregnancy must be as follows: Sectioning through the base of the ovum must reveal either a fresh corpus luteum encircling the ovum, or it must disclose the ovum lying close to the corpus luteum which must show signs that the ovum has passed through it.

Etiology. For the purpose of this paper, only the primary or true intraovarian pregnancy is considered. As unclear as is the entire etiology of all tubal ectopic gestations, so much more so is that of primary ovarian pregnancy. Many theories have been advanced with some factual evidence to support each. Sutton,[20] Teacher,[21] De Lee and Greenhill[22] and Litzenberg,[23] severally and together, have grouped the basic modes of primary ovarian implantation. These have been ably summarized by Wittenberg and Reis[24] into two main categories; namely, the interstitial or intrafollicular in which the pregnancy is implanted either in the stroma or in the follicle itself, and the peripheral in which the sac grows out into the peritoneal cavity. This latter method of implantation may be either superficial or suprafollicular.

Many theories have been advanced as to the exact physiologic-pathologic process which results in the fertilization and retention of the ovum in the ovary. Moreover, exact microscopic and operative data in most cases reported are either lacking or incomplete, and in general the number of cases is too few to formulate an exact etiologic picture. However, from the cases already reported, coupled with our knowledge of the normal physiologic processes of ovulation and fertilization, many theoretic descriptions of the etiology of ovarian pregnancy have been postulated. There is no question from the reports reviewed that all four types of true ovarian pregnancy mentioned previously do occur.

In discussing the possibility of *intrafollicular pregnancy*, Leopold[25] postulated an ovum which was impeded in its progress by a narrow tortuous channel. Such a condition would allow for the penetration of the sperm into the ovary, while holding the ovum in a static position during the process of maturation. Wollner[4] stated that the reasons most likely to account for the ovum not leaving the follicle are that: (1) a small blood clot occludes the osteum (which theory cannot explain spermatic penetration); (2) alterations in the ovulation process occur, whereby the egg itself is dislodged or misplaced in the follicle and thus is not washed out by the stream of escaping follicular fluid. He also stated that another logical explanation of the retention of the ovum is insufficient force of intrafollicular pressure which may not be great enough to free the cumulus oophorus and push it through a pathologic tunica albuginea. Normally the sudden changes in this pressure within the follicle carry the ovum out, but in cases in which resistance of the capsule is increased this pressure is too small and the ovum is retained. Such a status could be present in chronic perioopheritis and would explain partially the supposedly greater incidence of ovarian pregnancy when sterility has been a long-standing factor. Both of these theories account for the centrally located intrafollicular implantation of the ovum. Hewetson and Lloyd[26] offer another ingenious mechanism whereby they postulate that the egg is fertilized very near the rupture of the follicle and burrows more deeply into the ovary by virtue of its own cytolytic powers, following the channel of rupture back to the early corpus luteum.

Interstitial ovarian implantation occurs when the fertilized ovum is implanted in the stroma of the ovary. Fertilization occurs, therefore, outside the follicle after it has ruptured, although still in the ovary itself. King[27] reported such an authentic case and theorized that the follicle burst laterally because of a tough and thickened capsule. In reporting this case he did not state whether the capsule itself was opened or whether the sperm was actually able to penetrate the tunica by means of its own lytic action. A similar authentic case of this type of implantation was reported by Golden.[28]

Superficial ovarian implantation is listed as the third possibility of ovarian gestational etiology. With this type of ectopic ovarian pregnancy, nidation occurs on the surface of the ovary or just under it. The fertilized ovum then burrows deeper into the ovarian tissue or

remains near the surface and expands outward. Here again such type of implantation can be explained by thickening of the capsule due to old healed disease, as exemplified by the cases described by Wollner[4] and King.[27] Ovarian endometriosis, a condition thought to be necessary for any nidation to occur (according to Webster[29] and Curtis[6]), was offered as an explanation of superficial implantation in the authentic cases of McKenzie,[30] Norton and Alter,[31] and Curtis.[6] Other investigators have thought that peritoneal adhesions to the ovary or cystic degeneration of the follicle before rupture may be the cause of superficial nidation. Barda[32] has reported a case which may be classified under this category and which he believed was due to retention of embryonic müllerian duct tissue in which implantation occurred.

Suprafollicular implantation is the term applied to that form of interstitial nidation in which even though the ovum ruptures from the follicle, it is retained in the ovary at the point of rupture. Such etiology is difficult to prove pathologically. Gerstel[33] and Seedorf[34] believe that they have reported cases in which such a process was present.

To whatever theory we may ultimately subscribe, the existence of two constant factors must be accepted concerning the etiology of primary ovarian pregnancy: (1) the ovum must remain imprisoned within the tunica albuginea of the ovary, either in the stroma or within the cavity of the follicle itself; and (2) the sperm must be able, and does, penetrate into the tissue of the ovary to fertilize that particular ovum. As an interesting sidelight, it has always been assumed that the egg, in order to be fertilized, must pass through two maturation phases, the second of which was thought to occur after rupture of the follicle when the ovum was already in the fallopian tube. If we postulate that a true primary ovarian pregnancy can occur either in the follicle or in the stroma, then it must be conceded that both stages of maturation may be accomplished while the egg is still within the ovary itself.

Most investigators have believed that the primary intrafollicular or interstitial types of ovarian pregnancy are the most common, as compared with the superficial and secondary types. Svenberg,[35] after reporting a case and after a thorough investigation of the current literature, has commented to this effect. Triete and Dieke[36] have made similar observations. Secondary implantation of the already fertilized egg on the ovary has a different etiologic basis. It must be considered as a dislodged ectopic tubal pregnancy which has nidated on the ovary. Here, pathologic implantation is due to tubal obstruction, resulting from changes in the functional activity of a healed diseased tube,[35,37] peritubal adhesions and functional changes in the tunica albuginea. Curtis,[6] in reporting a case of ovarian pregnancy, suggested that on the basis of clinical findings at laparotomy normal fertilization (at least in the case reported) occurred in the fallopian tube, but due to anatomic abnormalities the ovum migrated in the opposite direction and reimplanted itself in the ovary.

Numerically, both actually and relatively, true ovarian pregnancy must be considered as a rare obstetric and gynecologic complication. Young and Hawk,[38] in reporting a case of ovarian pregnancy, quote an incidence of 1 in 25,000 deliveries (0.7 per cent). Kuzma and Lillie[39] reported that three of a total of 200 ectopic gestations were ovarian in nature (1.5 per cent). Others have estimated the incidence as follows: Isbel and Bacon,[40] 0.9 per cent; Eckerson,[41] 0.29 per cent; Raymond,[42] 0.58 per cent; Courtiss,[5] 0.94 per cent; Nucci,[43] 1.5 per cent; Tabor and Crossett,[44] 2.7 per cent and Hertig,[45] 0.7 to 1.07 per cent.

The case described herein is the first known proved case of primary intrafollicular ovarian pregnancy operated upon at the Harlem Hospital for as long a period of time as records are available. This hospital has an extremely high incidence of ectopic pregnancies. A study of these cases by Bobrow and Winkelstein[46] for the years 1943 to 1953 revealed a total number of 587 patients operated upon for ruptured ectopic pregnancies during that period of time. This would give the gross percentage rate of ovarian pregnancy as 0.17 per cent, which is lower than any other reported figures. In view of the statistically large number of ectopic gestations operated upon, we believe that this is a much truer incidence than any previous estimates. Similarly, the incidence of ovarian pregnancy as compared to all pregnancies (deliveries, abortions, ectopics and the like) has been calculated for a ten-year period as one in 52,833. The following case of true intrafollicular ovarian pregnancy, briefly outlined,

presents several interesting and illuminating factors.

CASE REPORT

Mrs. R. C. (Harlem Hospital No. 53-12485), a thirty-six year old para III, gravida VI, was admitted through the hospital emergency room to the Department of Gynecology on July 26, 1953, with the complaints of an episode of sudden severe sharp abdominal pain coupled with fainting which occurred several hours before admission. Following the return of consciousness she stated she felt very weak and that she vomited several times. There were no previous similar attacks. The pain was described as coming on without warning, knife-like in character, present over the entire abdomen and radiating to the back, shoulders and legs. Except for the usual childhood diseases her medical history was negative and without significance. Venereal infection and pelvic inflammatory disease were denied. There was no history of previous surgery.

Menstruation had begun when the patient was twelve years of age. Menses were regular, at twenty-eight-day intervals, with a normal flow for five days. She had had three full term, normal pregnancies and three spontaneous abortions, the last of which occurred less than a year before her present admission. Her last menstrual period had been on June 19, 1953, and was normal. The previous period, also normal, was on May 19th. Her expected menstrual flow should have occurred on July 17th. Except for the times when she was pregnant, and exclusive of the present delay, there never had been a time when she did not menstruate regularly. She had felt entirely well since the last menses up to the time of her present admission. There was no history of bleeding or spotting.

Physical examination at the time of admission revealed an apparently well developed, well nourished Negro woman who appeared to be in rather severe discomfort. She was crying, tossing about on the table and complaining of severe abdominal and bilateral shoulder pain. She appeared moderately pale and very apprehensive. The head, eyes, ears, nose and throat were normal with the exception of a moderate pallor of the conjunctiva and mucous membranes. Breast tissue was ample. The nipples were retracted and no secretion was noted. The heart sounds were fairly strong and regular. The lungs were clear except for a few dry scattered rales in the left base. The abdomen was moderately distended and tender throughout with rebound tenderness in both lower quadrants. Voluntary spasm was present, but no definite masses could be outlined. A shifting dullness was noted in both flanks. Bowel sounds were found to be present on auscultation of the abdomen.

On vaginal examination, normal parous external genitalia were noted. The vagina appeared to be well supported. The cervix was felt to be pushed slightly toward the right side; it was soft, closed and exquisitely tender to motion, especially toward the left. The fundus could not be accurately delineated, but was thought to be softened and about the size of a six- to eight-week gravidity. Both adnexal regions were acutely tender. Bulging was noted in both fornices and in the cul-de-sac. There was a slight amount of blood on the examining finger. On visual examination, the cervix appeared bluish and a minimal trickle of dark blood from the external os was seen. Needle puncture of the posterior cul-de-sac was positive for unclotted and unclottable blood. Rectovaginal examination showed a normal septum.

Blood pressure was 110/60 mm. Hg.; pulse 80/minute, strong and regular; temperature 99.6°F., hemoglobin 75 per cent (Sahli); estimated sedimentation rate 3 mm. in one-half hour.

On the basis of the physical findings a diagnosis of a ruptured ectopic gestation was made and the patient was prepared for immediate surgery. Exploratory laparotomy was begun approximately three hours after admission.

On opening the peritoneal cavity approximately 1,000 cc. of old and fresh fluid blood, together with large blood clots, were visualized. The pelvis was then explored, and disorder noted on the left side. This consisted of a large mass, approximately 20 by 15 cm., which was bluish in areas and covered with many adherent blood clots. The fallopian tube was visualized and appeared to be slightly larger in diameter than normal and reddened. The fimbriated end was free of the clotted mass and appeared to be open. The mass itself was suspended from the uterus by the ligament of the ovary. The opposite tube and ovary appeared to be normal. The left tube and ovarian mass were removed.

The postoperative course was entirely un-

FIG. 1. Fetus in corpus luteum.

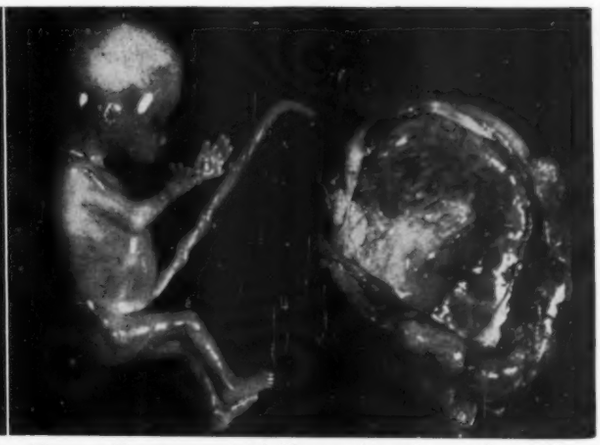

FIG. 2. Fetus removed illustrating placental attachment in corpus luteum.

eventful. Anemia resulting from loss of blood was corrected by transfusion of 1,000 cc. of whole blood, 500 cc. at the time of operation and 500 cc. on the first postoperative day. The patient was discharged on the ninth postoperative day.

The following is the report of the pathologic examination of the extirpated specimen. Pathological report (July 27, 1953, No. 53-2445): The specimen consisted of a soft cystic mass, measuring 12 by 6 by 7 cm., presenting on one surface, a fallopian tube bound down by dense adhesions but anatomically separated from the cystic mass. There was a bluish red cyst present on the anterior surface of the mass, measuring 2 by 1 cm. At one pole of the mass there was a portion of white tissue, measuring 5 by 3 by 2 cm. Small punctate hemorrhages were present on the surface. Section of the gross specimen revealed several cystic cavities, one of which was lined by a smooth shiny membrane, and on the floor of which was a large mass which appeared to be the maternal surface of a placenta. Section through this cavity revealed the presence of amniotic fluid, and a placenta with its membranes and cord which was attached to a contained fetus measuring 10 cm. from crown to rump. The placenta which was firmly attached to the wall was 10 cm. in diameter. (Figs. 1 and 2.) The tubal portion previously described measured 6 cm. in diameter and presented a small lumen.

Microscopic examination of the placental-ovarian region (Fig. 3) showed infiltration of the corpus luteum by trophoblastic elements of the placenta from within the cavity of the corpus luteum itself. Microscopic examination of the left fallopian tube showed the entire mucosa to be free and without any reaction indicative of placental implantation. Examination of the cornual end of the tube showed the lumen to be obliterated as the result of chronic salpingitis. The final diagnosis was intrafollicular ovarian pregnancy and chronic salpingitis.

COMMENTS

A comprehensive review of the literature has been made in order to determine the incidence, pathology and etiology of true ovarian pregnancy. It has been noted that many cases reported are not to be considered to belong to this category since they do not fulfill the criteria established. As a result of a review of all cases reported in the literature, we have been able to find 154 true primary ovarian pregnancies, to which the case presented herein is now added. This case fulfills all the criteria outlined by Cohnstein,[15] Spiegelberg,[16] Norris[17] and Williams.[18] The case itself presents several interesting, novel and illuminating features which should be discussed.

First is the fact that neither by history nor by physical examination could the true diagnosis be reached. Regarding symptomatology, it is generally agreed that a growing ectopic gestation, whether tubal, ovarian or abdominal, will present only those signs found in normal intrauterine gestation.[47] This status persists until such a time as rupture occurs, a blood vessel is eroded or the trophoblastic elements

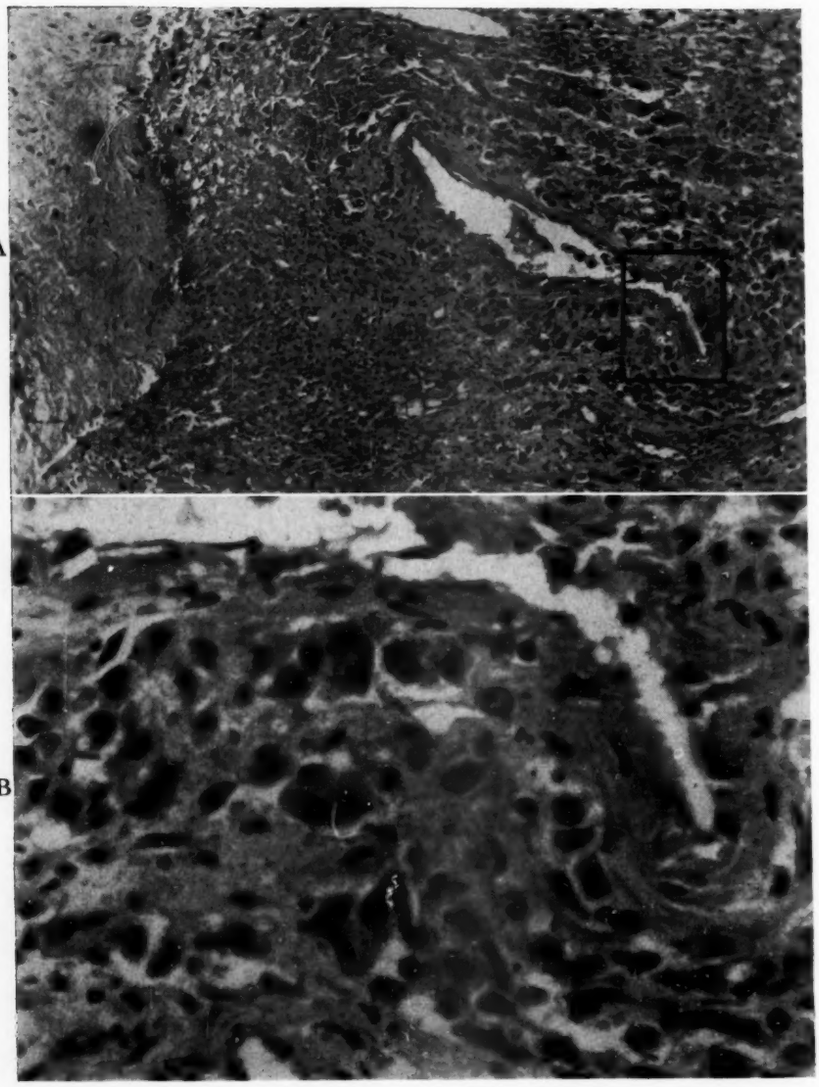

FIG. 3. A, section illustrating close arrangement of fetal and ovarian elements. B, detail of insert in 3A showing close approximation of villus syncytial cells and luteal cells.

perish. Before this time menstrual history, pain and pelvic examination are, at best, only mildly indicative of the existing disorder. When rupture does occur, hemoperitoneum develops and acute symptomatology results. This occurred in the case presented herein. It is evident that the acute phase of this patient's history is compatible with that of a ruptured ectopic gestation, without any history or physical findings pointing to the presence of a ruptured ovarian rather than tubal gestation.

Secondly, the history obtained demonstrated gross and perceptible incompatibilities between the existence of the amenorrhea and the pathologic findings. According to a carefully studied and reviewed recapitulation of the cycles during the six months preceding the present episode, no abnormalities in duration, amount or discomfort were noted. Likewise there were no variations in the intermenstrual interval, except for the ten-day period of amenorrhea before rupture. Yet, pathologic study of the fetus showed it to be of almost three months' size (10 cm.). It is evident, therefore, that the presence of the gestation in the ovary did not in any way impede the occurrence of at least two monthly regular vaginal bleedings, resembling in every respect a true menstrual flow.

Thirdly, the etiology of ovarian pregnancy in general, and of this ovarian pregnancy in particular, must be discussed. Certainly previous history of sterility in this case is not to be considered a factor, as thought by Kuzma and Lillie,[39] since this patient had had six previous gestations, the last less than one year before the present episode. No evidence of either vestigial müllerian remnants[32] or of ovarian endometriosis[29–31] were found on pathologic section of the tissues studied, either at the site of the pregnancy or throughout the remainder of the ovary. We believe, at least in part, that the basic causation of ovarian pregnancy is the same as that of all extrauterine gestations, namely, pelvic inflammatory disease. Although no direct history of genital infection could be obtained from the patient either directly or indirectly, it is most evident that some sort of inflammatory changes had occurred since the patient's last abortion. Such a condition might conceivably have arisen after abortion, or as the result of a new infectious process developing between that time and her present complaints. That such infection had been present is amply proved, both by the presence of old thick adhesions noted in the pelvis at the time of operation and by the pathologic report which stated that the lumen of the cornual end of the excised tube was closed as the result of chronic salpingitis. Furthermore, on examination of the fresh specimen it was believed that the capsule of the ovary was thickened, although no mention was made by the pathologist. The etiologic factor resulting in the development of an ovarian pregnancy may be chronic or healed pelvic infection in this case, which agrees basically with the findings and conclusions of King,[27] Curtis,[6] Stamm[48] and others.

Fourthly, an interesting and peculiar group of pathologic factors were noted which led to some unusual observations as to the sequence of events resulting in the fertilization of the ovum in the ovary. It has generally been assumed that after ovulation the egg is picked up by the fimbriated end of the tube and fertilized somewhere in its outer third. However, as the result of pelvic disease, both the capsule of the ovary and the fallopian tube of the same side were damaged, the capsule becoming thickened and the tube occluded at its cornual end. However, at operation the contralateral tube was found to be patent. The sequence of events, therefore, must have been as follows: Sperm, deposited in the vagina traveled through the uterine cavity and the contralateral tube. After leaving the tube it must have transmigrated the entire pelvic peritoneal cavity to reach the ovary. Since because of the damaged and thickened tunica albuginea the ovum was unable to leave the ovary, the sperm then had to penetrate through the ostium of the ruptured follicle. This sequence proves, therefore, that maturation can occur in the ovary and that the spermatozoa have the vitality and longevity to travel longer distances and through adverse conditions and still accomplish their primary function.

CONCLUSIONS

1. A case of true primary ovarian pregnancy, intrafollicular in origin and meeting the established criteria of Cohnstein, Spiegelberg and Norris, has been presented.

2. The literature of ovarian pregnancy has been reviewed and discussed. According to the present study, and including the present case, 155 cases of true ovarian pregnancy have been reported in the literature.

3. Diagnosis of the condition cannot be made in contradistinction to any other type of ectopic gestation and the final diagnosis rests with the operative and pathologic findings.

4. Operative and pathologic data are described which attribute the causation of ovarian pregnancy to changes in the genital tract occurring as the result of pelvic infection.

5. Proof of transmigration of the spermatozoa through the peritoneal cavity and ovarian maturation of the egg is demonstrated in the case described.

Acknowledgment: Appreciation and thanks are expressed to Dr. Arthur Lewson for clinical studies, and to Dr. Regina Ultmann for the pathologic reports included in this history.

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Mediastinal Abscess Following Instrumental Perforation of the Esophagus

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SURVIVAL following gastroscopic perforation of the thoracic esophagus, with delayed drainage of a huge mediastinal abscess and septicemia, has not been reported heretofore. In a series of 320 gastroscopies reported by Cropper et al.[1] a low esophageal perforation occurred and was treated by operative intervention. However, an esophagopleural fistula developed and the patient died on the twenty-sixth day.

A survey of all gastroscopic accidents in the available literature[2–10] reveals that of approximately 35,000 gastroscopies, there were twenty-five (0.71 per cent) instances in which perforation was strongly suspected or demonstrated at operation or necropsy. The site of perforation was equally divided between the cervical esophagus or hypopharynx and the stomach. Furthermore, it is evident that of these twenty-five cases, only five (all hypopharyngeal lesions) resulted fatally. We believe these facts justify Schindler's[11] statement that gastroscopic perforation of the upper gastrointestinal tract, particularly the thoracic esophagus, is extremely rare.

The following case is reported because of the variety of clinical events which delayed the correct diagnosis. The eventual complications and treatment demonstrate the possible ramifications of a suppurative mediastinitis. Ultimate survival of this patient was more remarkable because of an intercurrent septicemia, with an organism resistant to all antibiotics except chloramphenicol (chloromycetin®).

CASE REPORT

C. F., a forty-eight year old divorced woman, entered the Boston City Hospital complaining of sore throat, mid-epigastric discomfort and fever of three days' duration.

The patient had had postprandial epigastric discomfort for the past sixteen years, always relieved by food or alkali. She adhered to a bland diet and took antacids intermittently, doing quite well until sixteen months prior to admission when she had a severe episode of hematemesis and melena. She was admitted to the Boston City Hospital at that time, and responded to a medical ulcer regimen. Gastrointestinal series disclosed a prepyloric gastric ulcer of the lesser curvature. Surgery was advised but refused by the patient at this time. The patient did fairly well until one month before admission, when she again vomited a small amount of blood, noted tarry stools and intermittent, increasing abdominal pain. She was seen at another hospital and gastroscopy was advised. Three days prior to admission she underwent gastroscopic examination which revealed an ulcer of the lesser curvature. Following the examination, she complained of sore throat, moderate dysphagia and increasing mid-epigastric pain.

Physical examination revealed a slender, febrile, acutely ill woman. No unusual physical findings were noted except epigastric tenderness. Laboratory data showed an icterus index of 25, hematocrit of 32, and normal electrolytes and serum amylase. Blood culture was later reported negative. Urine revealed 2 plus bile. Admission chest film was regarded as normal, except for old, healed apical tuberculosis.

During the first twenty-four hours, her temperature rose to 103°F.; her pulse was 120, respirations 24 and she complained of severe, boring epigastric pain. Repeated blood studies showed a rising white cell count (22,000); therefore, she was given intravenous aureomycin.

Thirty-six hours after admission she was seen in consultation by a general surgeon who believed that, in view of her history and increasing epigastric complaints, penetration of

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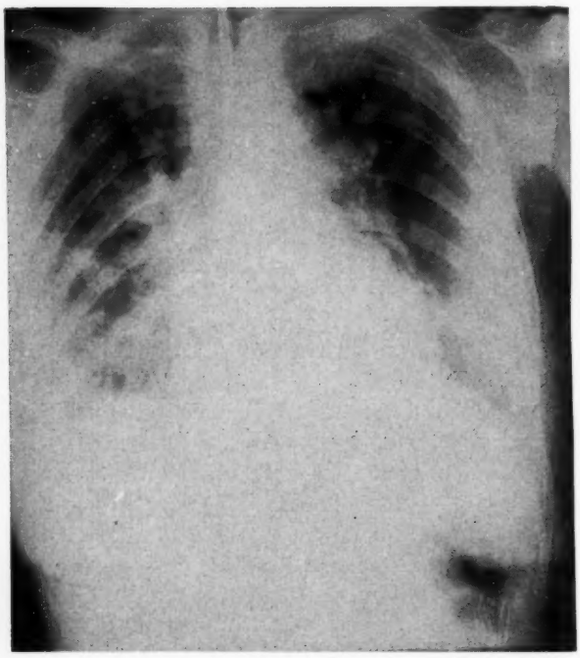

FIG. 1. X-ray taken twenty-four hours after gastrectomy, just prior to emergency pericardiostomy. Note widened cardiac silhouette with straight left border and bilateral pleural effusions.

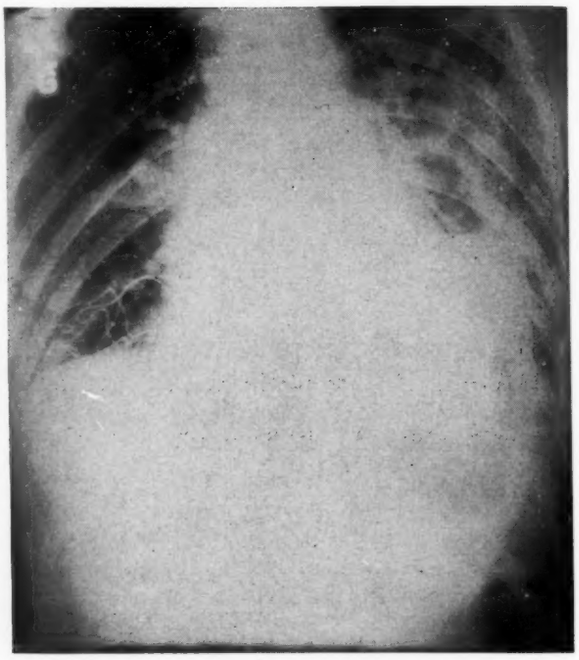

FIG. 2. X-ray taken three days after drainage of pericardium, showing huge left paracardiac mediastinal abscess with fluid level; subsequent drainage was carried out with anterior and bilateral posterior mediastinotomies.

the gastric ulcer was a strong possibility; laparotomy was advised. The patient underwent exploratory laparotomy on December 9, 1952. A puckered, scarred, 2 cm., benign-appearing ulcer of the lesser curvature was found. There was no evidence of perforation. No additional intraperitoneal pathology was found and subtotal gastric resection was performed.

A portable chest film (Fig. 1) taken the night of operation when the patient complained of dyspnea, revealed mediastinal widening and bilateral pleural effusion. Thoracentesis revealed clear, serous pleural fluid. A repeat film twelve hours later disclosed persistent mediastinal widening, with enlargement of the cardiac contour. An electrocardiogram showed low voltage and was interpreted as consistent with pericarditis. The patient became quite toxic and slightly cyanotic. The pulse rate was 130, with gallop rhythm, and the venous pressure was 175 mm. of water. Pitting dependent edema was noted, and a pleuropericardial friction rub was detected over the precordium for the first time. The patient received digitalis.

Following repeated aspirations of clear pleural fluid, she improved slightly, although she maintained an elevated temperature of 101° to 104°F., with gradually increasing signs of superior vena caval obstruction and persistent pericardial friction rub.

On the eighth day following gastrectomy she suddenly became alarmingly cyanotic, with a feeble, thready pulse, and manifested classic physical, roentgen and electrocardiographic findings of cardiac tamponade. That same day two blood cultures, taken three days earlier, were reported positive for hemolytic Staphylococcus aureus. At this time the patient was seen by the Thoracic Surgery Service and immediate pericardiostomy was advised for drainage of suspected suppurative pericarditis, secondary to instrumental esophageal perforation with possible rupture into the pericardium.

This procedure was carried out through a subxiphoid incision, evacuating 700 ml. of serosanguineous fluid from the pericardial sac, which later proved to be sterile. Clinical improvement was immediate, with a rise in systolic blood pressure from 70 to 100 mm. This improvement was transient. During the subsequent twelve hours the patient became markedly toxic, with rapid, labored respirations, slow pulse and subnormal temperature. Coarse rales were heard over both lung fields.

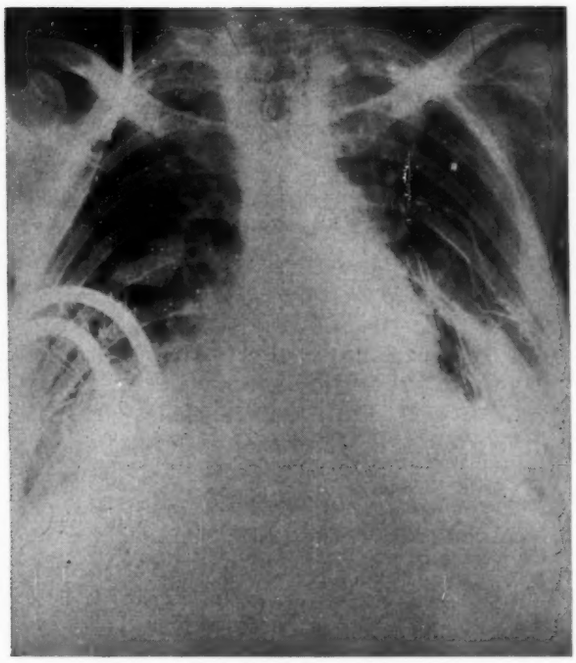

FIG. 3. X-ray taken following right posterior mediastinotomy with drainage tubes in place.

FIG. 4. X-ray taken following left posterior mediastinotomy; left lung and mediastinum have cleared.

The patient was expectorating copious, fetid, yellow sputum which also showed hemolytic Staph. aureus on culture. This organism proved to be moderately sensitive to chloramphenicol and only slightly sensitive to streptomycin and erythromycin. Therapy was begun with the following drugs: streptomycin, 1 gm. daily; erythromycin, 400 mg. every four hours; and chloramphenicol, 0.5 gm. twice daily intravenously. Chest films at this time revealed a left mediastinal abscess, with a fluid level and probable multiple parenchymal abscesses in the left lung field. (Fig. 2.)

During the forty-eight hours following pericardiostomy, the patient continued a septic course and began to complain of hoarseness and dysphagia. In view of the clinical appearance and the demonstration of an abscess cavity by x-ray, it was believed that exploratory anterior mediastinotomy was indicated. This was performed through the left fourth interspace parasternally, and the evacuation of a large, foul mediastinal abscess, considerably more posterior than anticipated, was accomplished. The anterior space was placed on water seal drainage and diluted Dakin's solution irrigations begun. Since it was evident that the mediastinal abscess had been inadequately drained by the anterior decompression, a period of three days was allowed for the patient to exhibit slow but definite improvement. At this time dependent right posterior mediastinotomy was carried out after preliminary lipiodol localization. (Fig. 3.) At exploration, evidence was found of wide extension of the abscess well over into the left retropleural space, but it was thought that adequate drainage might result from a predominately right-sided pocket. Drainage was established with large-bore rectal tubing and the wound irrigated daily with Dakin's solution.

Following this operation, on the thirteenth hospital day, the patient showed dramatic improvement, began to take oral feedings, became afebrile and slowly ambulant. Chloramphenicol therapy was continued in amounts of 0.5 gm. every six hours by mouth. The right retropleural space showed progressive diminution in size, the pulmonary lesions cleared and the blood cultures became sterile.

Iodochlorol® was injected into the small anterior mediastinotomy sinus tract, revealing a residual left retropleural pocket which did not communicate with the right posterior draining wound.

Approximately one month following admission, left posterior mediastinotomy was performed. During this procedure the esophagus

was palpated and felt to be indurated at about the junction of the middle and distal thirds. Barium swallow subsequently revealed a moderate extrinsic pressure defect at this point, but the contrast medium passed without significant obstruction.

The patient steadily improved, gaining 14 pounds. At discharge only two small healing sinus tracts persisted at the sites of the posterior mediastinotomies. At present, the patient is asymptomatic and working full time. (Fig. 4.)

Comment. Since this patient dated the onset of her acute symptoms to the time of gastroscopy, it seems reasonable to assume that the etiology of the mediastinal abscess was a small perforation at the middle or lower third portion of the esophagus. The persistent sore throat, increasing dysphagia and definite aggravation of the chronic epigastric pain suggest an endoscopic accident in the distal esophagus. By the fourth day following gastroscopy, which was the first hospital day, diffuse phlegmonous mediastinitis was developing. Evidence that this was an inflammatory lesion was noted by the rising temperature and white blood cell count, the beginning of toxicity, plus aggravation of pain and dysphagia.

On the fifth day of illness further corroboration of thoracic disease was obtained by finding no acute inflammatory focus in the abdomen at laparotomy. The day following gastrectomy the progression of the mediastinitis was manifested by bilateral pleuritis and effusion. (Fig. 2.) Concomitant with the pleural effusion, effusion also occurred in the pericardial sac. Enlargement of the cardiac contour, in addition to classic physical findings, indicated the precipitous onset of tamponade necessitating emergency decompression.

Prior to the pericardial effusion, a positive blood culture for hemolytic Staph. aureus revealed that her course was further complicated by septicemia.

The patient's extremely toxic course, with evidence of almost overwhelming sepsis, plus the fact that no inflammatory collection had yet been reached, suggested an undrained mediastinal abscess as the primary etiology. Substantiation of this was seen in the x-ray observation of a large paracardiac radiolucent shadow with a fluid level. (Fig. 2.) On the fifteenth day following perforation preliminary drainage by anterior mediastinotomy, of what eventually proved to be only the anterior extension of a huge posterior mediastinal abscess, provided definitive treatment.

COMMENTS

Although esophageal perforation is a serious accident, the majority of cases since 1935 have not been fatal. Jemerin[12] states that about 1936 surgery began to be recognized as the treatment of choice. Prior to this only 50 per cent of the cases were treated surgically.

Posterior exploratory mediastinotomy was first described by Nassilow[13] in 1888. The operation was refined by Lillenthal[14] in 1923, but in essence the same technic is followed today.

Prompt institution of paravertebral drainage is necessary because most of these infections are anaerobic. The establishment of drainage not only permits evacuation of the abscess contents but also produces aerobiosis. Because of the incidence (80 per cent in his series) of associated empyema in low posterior mediastinal abscesses, Seybold[15] advises wide opening of the pleura through the same incision if there is evidence of air or fluid in the pleural space.

The importance of immediate surgical treatment, once the diagnosis of traumatic perforation is suspected, cannot be overemphasized. In the early case, that seen within the first twenty-four to forty-eight hours, this consists of open thoracotomy with suture of the perforation and drainage of the mediastinal and pleural spaces. In the late case, adequate drainage of the mediastinum or pleural space, or both, must be carried out as described.

It is evident[16–18] that the transthoracic approach to recent esophageal perforations is safe, and posterior mediastinotomy should be reserved for the patient in whom a suppurative mediastinal collection can be demonstrated by means of appropriate roentgenograms and preliminary aspirations.

SUMMARY

A case is reported of perforation of the thoracic esophagus following examination with a flexible gastroscope. The subsequent development of acute symptomatology in a patient with a known peptic ulcer resulted in partial gastrectomy before the progressive mediastinitis was recognized. The complications of sympathetic pericarditis with tamponade and pleural effusion represented pathology not

infrequently associated with suppurative mediastinitis. The eventual drainage of the pericardium and of a huge mediastinal abscess by combined anterior and bilateral posterior mediastinotomies, following hemolytic staphylococcus septicemia, provided successful surgical treatment for a lesion with an inevitably lethal outcome.

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Urethral Injuries

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TRAUMATIC surgery is an old science, described by Imhotep about 3000 B.C. during the construction of the pyramids, and by Hippocrates who regarded rupture of the bladder and urethra fatal. Today, although considered less catastrophic in the light of scientific progress, trauma due to common accidents requires immediate treatment if fatality is to be avoided.

Traumatic rupture of the urethra has been discussed by many authors. In 1872 Casaux[3] stated that in the absence of urinary retention the lesion should be left alone and surgery resorted to only if catheterization failed. Bollard,[2] in 1875, recommended a wide incision and said that "a premature incision is even better than one too late." A half century later the same difference of opinion existed. Higgins and Marion were satisfied with passage of a catheter alone, while others such as White[14] and Young[15] urged plastic repair.

We have noted from the literature a mortality rate of between 18 and 60 per cent due to infection following urethral injury. The series to be reported comprises four cases of urethral trauma with infection spreading to the surrounding tissue; no fatalities occurred. It is our opinion that a thorough knowledge of the condition requires that the surgeon possess a detailed picture of the local anatomy.

The triangular ligament or urogenital diaphragm consists of dense fibrous tissue arranged in two parallel layers about 1 cm. apart. This is firmly fixed to the bony pelvis along each descending ramus from the symphysis almost to the ischial tuberosities, distinctly separating the deep from the superficial pelvic structures. The male urethra penetrates the diaphragm perpendicularly near its center. Consequently, the urethra here is a stationary organ, rendered vulnerable at this point. Extravasation of blood and urine due to rupture of the urethra above the urogenital diaphragm is regularly confined to the tissue superior to this structure. The course and extent of the extravasation upward is determined by the periprostatic and perivesical fascial cleavage planes and force exerted by the contracting bladder. Extravasation of blood and urine due to rupture of the urethra below the diaphragm is confined to the area distal to this structure. Foulds[6] points out that when rupture occurs between the layers of the ligament, the superior layer may also be ruptured, thus sending the extravasation flow upward into the space of Retzius. Berry[1] states that the amount of blood is often in inverse proportion to the extent of injury. This is explained by the fact that when complete rupture occurs, the distal end of the urethra is blocked or compressed and the blood extravasates elsewhere, accompanied by some extravasation of urine.

Normal urine, when injected experimentally into living tissue, provokes minimal local reaction. The overwhelming rapid toxicity and septic infection seen in these patients is due to malignant bacteria harbored in the urethra.

CASE REPORTS

CASE 1. On April 2, 1954, a male infant was delivered of a white female, para III, gravida III. Spontaneous delivery followed a normal prenatal course. Examination after birth revealed no anomalous genital organs; physical findings were negative. At the age of two days the baby was circumcised. Scrotal swelling was noted the same night. This became marked with induration up to the level of a point between the umbilicus and symphysis pubis. An immediate urologic consultation was requested. Gross findings at this time were as follows: scrotal enlargement with a dusky discoloration and fluctuant edema associated with a spreading cellulitis involving the external genitalia (penis and scrotum) and inguinal regions up to the hypogastric abdominal area. At the frenum of the glans penis a suture was found constricting the urethra. A diagnosis was established of

postoperative anuria of twelve hours' duration with urinary extravasation due to urethral constriction caused by a suture placed during circumcision. Immediate surgery was performed.

Upon removal of the constricting suture the baby voided spontaneously. The stream was projectile. Emergency surgery included multiple linear incisions made through the skin and subcutaneous Colles' fascia, three in the right and left anterior scrotal sac, one in either inguinal area and one suprapubically. In order that each incision intercommunicate, the skin and fascia were bluntly undermined and rubber tissue drains were inserted. The normal tissue surrounding the cellulitis was infiltrated with bacitracin solution consisting of 500 units per cc. of isotonic saline. A No. 10 catheter was readily passed and clear urine was obtained.

Postoperatively the patient received 150,000 units of penicillin intramuscularly twice daily. Continuous warm, wet saline compresses were applied to the wounds. The incisions were irrigated with isotonic saline solution as required. After four weeks wound drainage ceased and healing became complete. The infant was discharged in good condition, free of any local defect or urinary symptoms.

CASE II. On June 18, 1953, a sixty-four year old white man was admitted to the hospital due to urinary retention of two days' duration. History was obtained of an old rheumatic heart disease and inability to void. On physical examination the penis was found to be discolored and swollen to double its normal size, and active hyperemia with a fluctuant, glistening skin was evident, most predominant on the dorsal surface. The lower abdomen gave evidence of a marked spreading cellulitis reaching phlegmatic proportions. This extended from the penis to the vicinity of the umbilicus and laterally to both flank regions. At this time the rheumatic heart disease was confirmed. A diagnosis of possible traumatic rupture of the urethra with extravasation of urine was based upon positive findings.

Suprapubic cystostomy was performed and multiple, linear, intercommunicating incisions were made in the phlegmatic area, a drain being placed in each incision. The injected subcutaneous tissue was dissected, trabeculations were broken, and suppurative material was aspirated. After a saline irrigation of the infected area, bacitracin solution (1,000 units per 2 cc. of saline) was injected at the demarcating line of cellulitis to inhibit further spread of the infection. Similar incisions were made on the penis. By inserting the index finger in the posterior urethra a Foley urethral catheter was introduced, with difficulty, during the procedure. Tetanus antitoxin and gas gangrene serum were administered. The diagnosis of urinary extravasation due to perforation of the urethra in the area of the vesical neck and prostate was confirmed.

A seropurulent exudate from the multiple incisions persisted for more than a week. By June 30th both abdomen and genitalia had responded to treatment; all drains were removed. The Pezzer and Foley catheters were draining adequately. A cystourethrography on July 12th visualized multiple bladder diverticuli of varying sizes and an enlarged prostate gland. The urethrogram revealed an intact urethra. The patient was discharged from the hospital on July 22nd with a suprapubic catheter in place; this was to be irrigated at regular intervals. He was readmitted on September 20th and transurethral resection with vasectomy was performed. One month later he was discharged from the hospital completely recovered.

CASE III. On October 14, 1953, a sixty-five year old white man was admitted to the hospital in mild shock, complaining of severe scrotal pain and inability to void. The patient stated that six hours previously a large piece of wood which he had been chopping struck him in the groin, and since that time a small amount of blood had been passed through the urethra. Past history was irrelevant. Physical examination revealed marked scrotal edema and ecchymosis, the swelling extending to the penis, groin and lower abdomen. The entire area gave evidence of a pronounced spreading cellulitis, reaching phlegmatic proportions, with discoloration of the skin. There were no other indicative physical findings. An attempt to pass a catheter failed, blood being withdrawn upon removal. Pelvic fracture was eliminated by a negative x-ray. A diagnosis was made of traumatic laceration of the bulbous urethra with extravasation of urine and blood, accompanied by urinary retention.

Immediate surgery included suprapubic cystostomy and multiple, linear, intercommunicat-

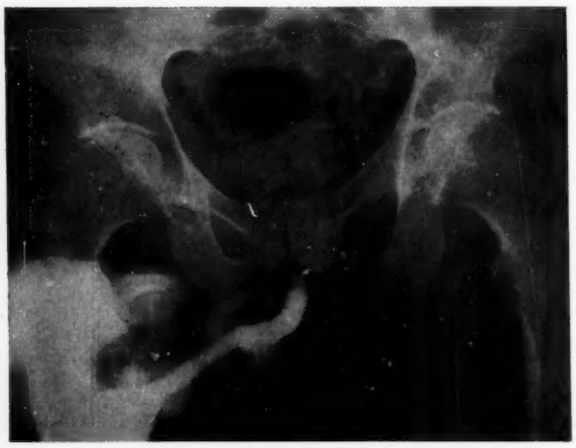

FIG. 1. Case IV. X-ray of the urethra after repair of fistula.

ing incisions of the lower abdominal wall and scrotum. After irrigation with bacitracin solution, rubber drains were inserted in each incision. Urine obtained from the bladder via cystostomy was negative for blood. Digital palpation elicited a moderate contracture of the vesical neck and a normal prostate. Sounds were passed by retrograde and antegrade method until the tips met, and a catheter was then introduced through the urethra. Bacitracin solution (1,000 units per 2 cc.) was injected into the area surrounding the cellulitis to inhibit the spread of infection. The diagnosis was confirmed during the procedure.

By the fifth postoperative day the patient's general condition had improved, suprapubic and urethral catheters were draining satisfactorily and infection had subsided. The rubber drains were removed. Sutures were removed on the ninth postoperative day. The wounds appeared clean and dry. A small amount of serous drainage from the scrotum persisted. By November 10th, infection and edema had completely subsided. Five days later the suprapubic catheter was removed and the urethral catheter was changed. On November 25th, the urethral catheter was removed and the patient voided spontaneously, with no subsequent symptoms. Follow-up care revealed that the laceration of the bulbous urethra had healed completely in response to treatment.

CASE IV. A forty-five year old white man was admitted to the hospital on September 24, 1953, with third degree burns of both lower extremities, the perineum and external genitalia. Emergency treatment for shock and burns was immediately instituted and a Foley catheter inserted. The burned surface responded well to débridement and skin grafts. When the patient's general condition permitted, suprapubic cystostomy for promotion of adequate drainage was performed. However, the presence of necrotic tissue caused a periurethral infection with perineal abscess and extensive urethrocutaneous fistulas of the posterior third of the anterior urethra, resulting in urinary extravasation. Examination revealed swelling and tenderness over the penoscrotal and perineoscrotal region from which a large amount of purulent material was expressed. The infection subsided completely in response to conservative treatment.

Cystourethroscopy and cystourethrography revealed that two urethral fistulas of the penis communicated with the anterior urethra. One, about 3 mm. in diameter, was located on the right lateral aspect of the middle third of the penis; the other, about 5 cm. in length and 2 cm. in width, was situated in the penoscrotal area. A urethroplasty performed in November, 1954, succeeded in only diminishing the size of the fistulas, the persistence of both openings being demonstrated upon cystoscopy during the same month. A second urethroplasty, for which the patient was prepared with continuous bacitracin solution dressings beginning five days prior to surgery, was performed on February 25, 1955. Complete closure of both fistulas was effected at this time. One month later the suprapubic catheter was removed, and a Foley urethral catheter was inserted without difficulty. Daily bladder irrigations, along with the administration of antibiotics, prevented infection of the bladder. A urethrogram on March 25, 1955, visualized a pseudodiverticular-like dilatation of the proximal portion of the penile urethra with no evidence of urinary extravasation. (Fig. 1.) The fistula is now closed and the patient voids spontaneously.

OBSERVATIONS

The cases reviewed herein exemplify the various types of anterior and posterior urethral injury accompanied by urinary extravasation. Similar injuries due to pelvic fracture received in automobile accidents (which are treated more frequently than ever before) have been

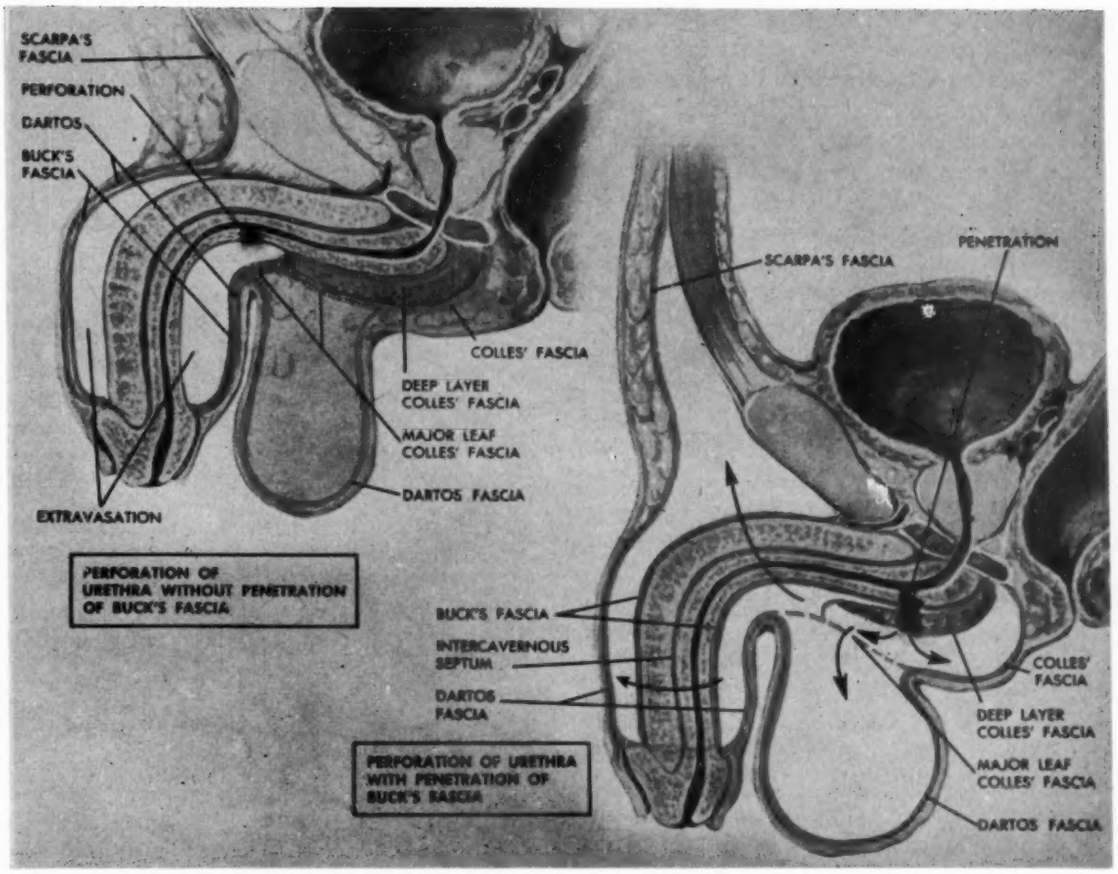

FIG. 2. The pathways of urinary extravasation. (From NETTER, F. H. The Ciba Collection of Medical Illustrations, vol. 2, p. 35. Summit, New Jersey, 1954. Copyright Ciba Pharmaceutical Products, Inc.)

deliberately omitted, the basic problem being the same.

Extravasation of urine does not necessarily imply urethral trauma, as demonstrated in Case I. In this instance the anterior urethra was ligated during circumcision and extravasation occurred as a result of the involuntary intravesical hydrostatic pressure of the bladder. Wesson,[13] in 1929, injected fluid intraurethrally under pressure at the posterior urethra and found that the fluid, after penetrating the urethral membrane, dissected the corpora cavernosa away from the corpus spongiosum and fascia of the penis. He illustrated on microscopic examination that no definite sheath, but a numerous condensation of connective tissue which later forms Buck's and Colles' fascia, exists in the fetus at term. The common pathway of extravasation is ventral, the urine being confined temporarily by Colles' fascia. Because of the dense fascial partitions within the superficial perineal interspace the fluid tends to pass from the perineum down into the scrotum and then up over the pubes. It may ascend as far as the axilla.

In Cases II and III urinary retention was indicated by distress upon attempted micturition and gradual distention of the bladder. Here the urine escaped into the surrounding tissue through the urethral defect, involuntarily because of abnormal intravesical pressure or voluntarily upon the patients' attempt to void. (Fig. 2.) Extravasation in Case IV followed perforation of the necrotic urethral tissue, resulting from successive attempts to pass a catheter. The tissue in this area had been devitalized as a result of severe burns. The course of extravasation in each instance conformed to the pattern just described.

COMMENTS

To avoid fatality in instances of urethral injury, immediate treatment is required. Fol-

lowing emergency measures necessary to combat shock, suprapubic cystostomy with diversion of the urinary stream should be performed. This procedure was followed in Cases II, III and IV. Next in importance, in order to inhibit spread and prevent further infection, is drainage of the area to which the urine has extravasated. This was accomplished successfully through multiple, intercommunicating incisions into which rubber drains were inserted. The uninvolved tissue surrounding the limiting area of spreading cellulitis was injected with a bacitracin solution of 500 units per cc. of isotonic saline. A soft rubber indwelling urethral catheter is recommended to splint the urethra and aid in proper healing. This measure proved satisfactory in this series.

SUMMARY

An historical sketch of urethral injury and treatment is presented, and four cases of injury accompanied by urinary extravasation, all successfully treated, are reported. The anatomy of the urethra is described and the mechanism of extravasation discussed. It is concluded that the prevention of mortality depends upon immediate treatment, as instituted in the cases analyzed herein.

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Solitary Cecal Diverticulitis

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SOLITARY cecal diverticulitis closely simulates acute appendicitis. The differential diagnosis of pain in the right lower quadrant of the abdomen should always include consideration of this unusual condition. Since appendicitis is the most common surgical lesion in this area of the abdomen, it is the usual preoperative diagnosis. However, cecal diverticulitis should be kept in mind and searched for in the absence of other operative findings to explain the clinical picture.

The surprising occurrence of four cases during a period of ten months at the Jewish Hospital of Brooklyn drew the attention of the authors to this infrequent condition. Search of the hospital records brought to light an additional case occurring five years previously, making a total of five cases in the past fifteen years.

Solitary cecal diverticulitis should not be confused with multiple diverticulitis which is most common in the descending colon but may involve the cecum and the ascending colon. The first recorded case of cecal diverticulitis was described by Potier[1] in 1912. The condition is uncommon; until Anderson[2] reviewed the literature in 1947 and added nine cases from the Mayo Clinic, the total of reported cases was 100. Since then thirty-three additional cases have been recorded.

CASE REPORTS

CASE I. E. R. (No. 323584), a thirty-nine year old woman, was admitted to the hospital on February 3, 1949, complaining of pain in the right lower quadrant of the abdomen of twenty hours' duration. There was no nausea or vomiting. Physical examination showed tenderness and moderate muscle spasm in the right lower quadrant of the abdomen. The urine was normal. The white blood cell count was 10,550, with 75 per cent polymorphonuclear leukocytes and 11 band cells. A diagnosis of acute appendicitis was made and operation performed through a lower right rectus incision. An acutely inflamed diverticulum, measuring 3 cm. at its widest diameter, was found on the lateral aspect of the cecum. The diverticulum was excised and the cecum closed with two layers of sutures. Appendectomy was also performed. Microscopic examination showed acute diverticulitis of the cecum and lymphoid hyperplasia of the appendix. The patient made an uneventful recovery.

CASE II. H. S. (No. 367275), a twenty-five year old white man, was admitted on October 26, 1953, complaining of sharp pain localized in the right lower quadrant of the abdomen of twenty-four hours' duration. There was no nausea or vomiting. Physical examination showed tenderness over McBurney's point, associated with moderate muscle spasm and rebound tenderness. The urine contained 2 plus acetone. The white blood cell count was 13,600 with 83 per cent polymorphonuclear leukocytes and 2 band cells. A diagnosis of acute appendicitis was made and operation was performed through a McBurney incision. An inflammatory mass was found on the anteromedial border of the cecum. A cecotomy was performed, making evident the presence of an acutely inflamed diverticulum. The cecum was closed leaving the diverticulum undisturbed. An additional finding was a carcinoid tumor of the appendix, which was removed. The patient made an uneventful recovery and has since been asymptomatic.

CASE III. M. E. (No. 382209), a thirty year old white man, was admitted on March 22, 1954, complaining of pain in the right lower quadrant of the abdomen of twenty-four hours' duration. There was no other associated symptoms such as nausea or vomiting. Physical examination revealed direct and rebound tenderness over McBurney's point, associated with moderate muscle spasm. The urine was normal. The white blood cell count was 17,100. A preoperative diagnosis of acute appendicitis

FIG. 1. Cecal diverticulum, Case III. The specimen has been opened to show the mucosal surface.

was made, but cecal diverticulitis was also considered. Operation was performed through a McBurney incision. On the anteromedial aspect of the cecum 1 cm. distal to the ileocecal valve there was an acutely inflamed diverticulum. The diverticulum was excised and the cecum closed with two layers of sutures. Appendectomy was also performed. The pathologic diagnosis was diverticulum of the cecum with acute diverticulitis. The patient made an uneventful recovery. (Figs. 1 and 2.)

CASE IV. P. G. (No. 382383), a fifty-six year old white woman, was admitted on April 8, 1954, complaining of epigastric pain and indigestion of two days' duration. The pain localized in the right lower quadrant one day prior to admission. There was no nausea or vomiting. Physical examination showed direct and rebound tenderness in the right lower quadrant, associated with muscle spasm. The urine was normal. The white blood cell count was 15,200, with 81 per cent polymorphonuclear leukocytes. Operation was performed through a McBurney incision. A hard, indurated mass measuring 4 by 6 cm. was present on the lateral border of the cecum. Since carcinoma could not be ruled out, right colectomy and ileotransverse colostomy were performed. Microscopic examination showed acute cecal diverticulitis and acute appendicitis. The patient made an uneventful recovery.

CASE V. M. P. (No. 386810), a forty-nine year old white man, was admitted on September 5, 1954, complaining of vague pain in the upper quadrant and right lower quadrant of the abdomen of six days' duration. The patient never vomited but had been nauseated for the previous three days. The temperature was 99°F. There was mild direct and rebound tenderness in the right lower quadrant, associated with moderate muscle spasm. The urine was normal. The white blood cell count was 12,800, with 76 per cent polymorphonuclear leukocytes and 1 band cell. A diagnosis of acute appendicitis was made and operation was performed though a McBurney incision. The appendix was found to be normal. On the anteromedial wall of the cecum overlying the ileocecal valve was an inflammatory mass measuring 7 by 4 cm. The diverticulum was excised and the cecum closed with a continuous layer of chromic No. 00 suture and a second layer of interrupted black silk sutures. A cigarette drain was inserted in the lateral cecal fossa. The specimen was reported as acute suppurative diverticulitis. The patient made an uneventful recovery.

COMMENT

Cecal diverticulum, as in other diverticula of the intestinal tract, may be divided into two types: the congenital or true diverticulum in which all layers of the bowel wall are present, and acquired diverticulum in which there is a deficiency of the muscularis. Most of the diverticula in the cecum are true, although in some cases the muscular layer cannot be demonstrated because of inflammatory changes. The fact that the cecal diverticulum is solitary would suggest that it is not acquired, in contrast to the multiple distribution of sigmoid diverticula. Solitary cecal diverticulitis has been reported in patients ranging from ten to sixty-four years in age, over 30 per cent occurring in patients under the age of forty. This, too, is in sharp contrast to the age incidence in multiple diverticulitis in which only 5 per cent occurred in patients under forty years of age.

The diverticula communicate with the lumen of the cecum through a narrow neck, and stagnation of fecal contents together with ulceration of the mucosa may be an initiating factor in producing inflammation. Obstruction by a fecalith has been found in some cases. The diverticula are usually located between the anterior and posterolateral taenia of the cecum but may be located medially as well as posteriorly. It is rare for perforation of an

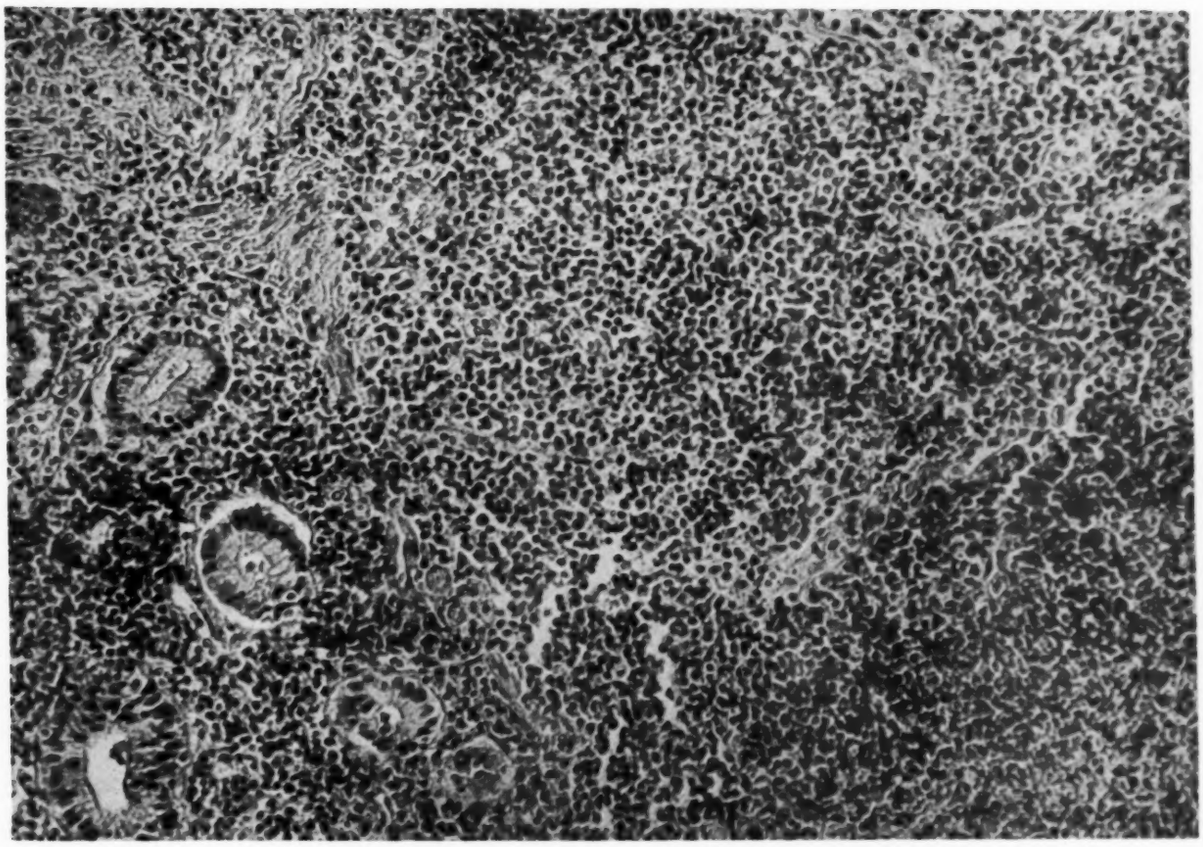

FIG. 2. Photomicrograph showing acute inflammatory reaction.

inflamed cecal diverticulum to result in diffuse peritonitis. Perforation may result in abscess formation, which produces so much induration as to be mistaken for a malignant tumor.

Eighty-four per cent of the cases reported in Anderson's[2] series were diagnosed preoperatively as appendicitis and only 6 per cent were recorded as having a correct preoperative diagnosis. Analysis of our cases indicates that there are certain clinical features which might suggest the diagnosis of cecal diverticulitis: absence of vomiting, moderate abdominal signs and occasionally a more prolonged history than one usually encounters in acute appendicitis. Carcinoma of the cecum, ulcerative colitis, terminal ileitis, tuberculosis, actinomycosis and non-specific ulcer of the cecum may be considered in the differential diagnosis.

The preoperative diagnosis is not of paramount importance since the clinical signs will usually indicate exploration. However, recognition of the correct pathologic diagnosis at operation is important to determine the proper choice of procedure. The types of procedure that have been used have been numerous, varying from such major operations as right colectomy, cecectomy and exteriorization to leaving the diverticulum alone. A small uncomplicated diverticulum may be inverted through a purse-string suture. A large indurated diverticulum will require excision and careful two-layer closure of the defect in the cecal wall. Larger inflamed diverticula lying close to the ileocecal valve or between the leaves of the mesentery so as to jeopardize the cecal blood supply may require hemicolectomy. In cases in which the correct diagnosis is not apparent cecotomy should be performed to see the mucosal side of lesion. The diagnosis will then usually become self-evident. The treatment of choice is simple diverticulectomy when possible.

SUMMARY

Solitary cecal diverticulitis is an infrequent condition which simulates acute appendicitis. It should be considered in the differential diagnosis of pain in the right lower quadrant

of the abdomen. Clinical features which may suggest this diagnosis are absence of vomiting, moderate abdominal signs and occasionally a more prolonged history then one usually encounters in acute appendicitis. Recognition of the correct pathologic diagnosis at operation will determine the proper choice of procedure. Simple diverticulectomy is the treatment of choice when possible.

Acknowledgment: Grateful acknowledgment is made for permission to include one case of Dr. Henry W. Louria and one case of Dr. Louis J. Morse.

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Glenn and Hays studied the records of over 4,000 patients who had been operated upon for biliary tract disease. Patients under the age of fifty seldom presented postoperative complications. The actual incidence was slightly more than half of 1 per cent. From ages fifty to sixty-four the incidence of complications after biliary surgery jumped to 2½ per cent, and after the age of sixty-five it rose to almost 7 per cent. The moral is, of course, to perform needed gallbladder and biliary tract surgery before the patient is fifty years of age if the disease is present at that time (which it usually is). (*Richard A. Leonardo, M.D.*)

Tumefactive Pigmented Villonodular Synovitis

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JAFFE, Lichtenstein and Sutro[1] in 1941 proposed the term "pigmented villonodular synovitis" for a synovial lesion showing focal collections of large polyhedral cells, which in turn give rise to foam cells, hemosiderin cells and multinuclear giant cells.[1]

The etiology of this synovial lesion showing the cytologic and proliferative complex demarcation in some instances from a neoplastic type of lesion was interpreted by Jaffe et al. as "inflammatory in type." However, prior to the present accepted terminology, "pigmented villonodular synovitis," other authors (Geschicter and Copeland,[2] DeSanto and Wilson,[3] and Marsden [4] the latter reporting on 100 consecutive operations on the knee) classified this synovial lesion as neoplastic in character. In October, 1954, at a conference, Lichtenstein presented a tumor-like mass removed from a

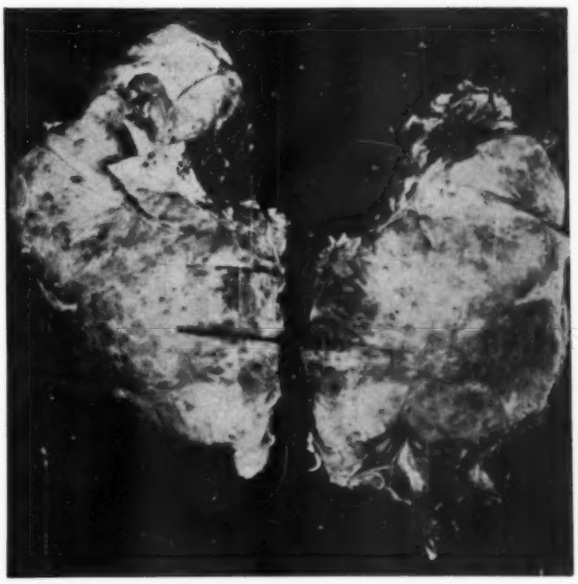

FIG. 1A. Tumor-like mass.

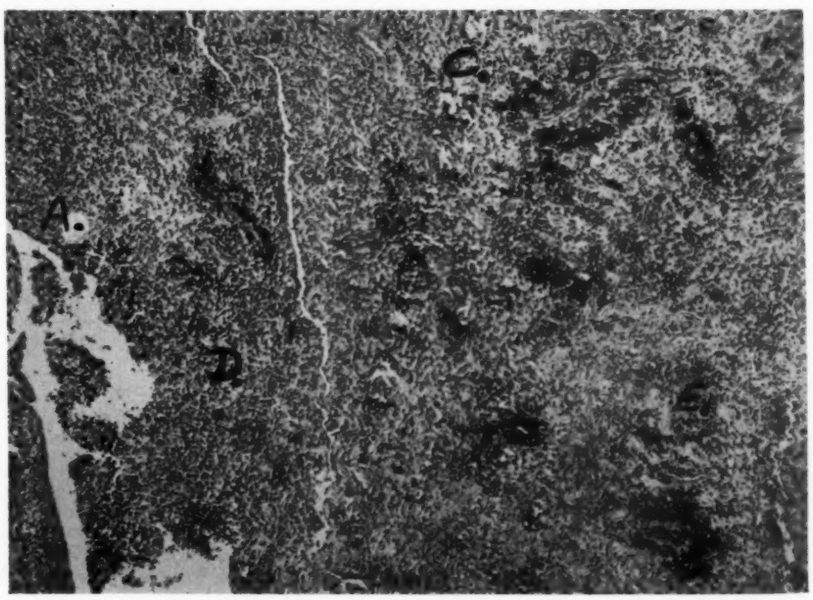

FIG. 1B. Photomicrograph of synovial lesion. A, Synovial clefts; B, hemosideric phagocytes; C, foam cells; D, polyhedral cells; E, giant cells.

FIG. 2. The lesion on the anterior lateral surface above right knee.

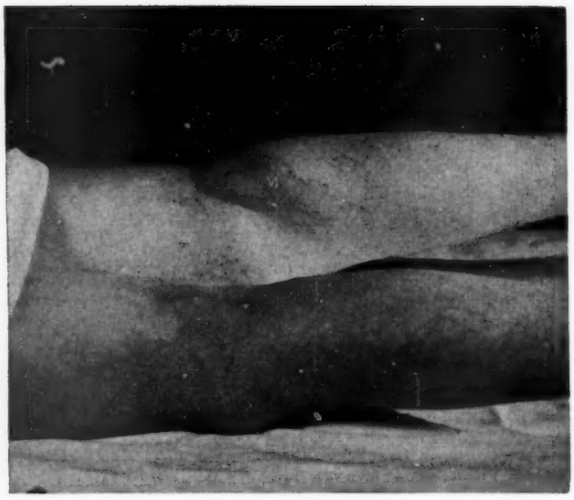

FIG. 3. The lesion on the posterior surface below knee.

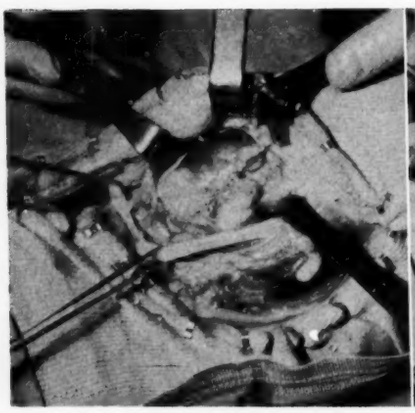

FIG. 4. Synovial tumor mass; note the retraction of peroneal nerve.

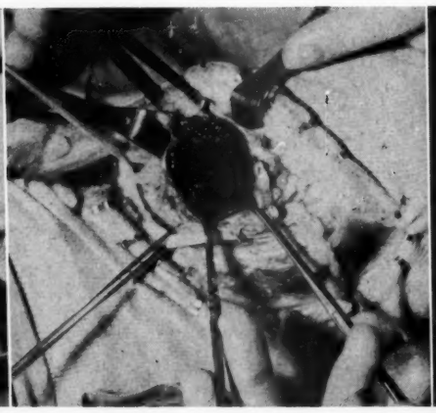

FIG. 5. Tumor mass imbeded into muscle substance.

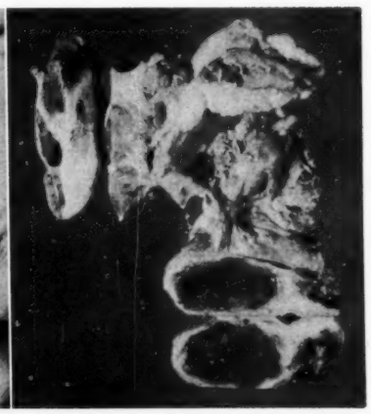

FIG. 6. Diffuse synovial tumor with portions of muscle.

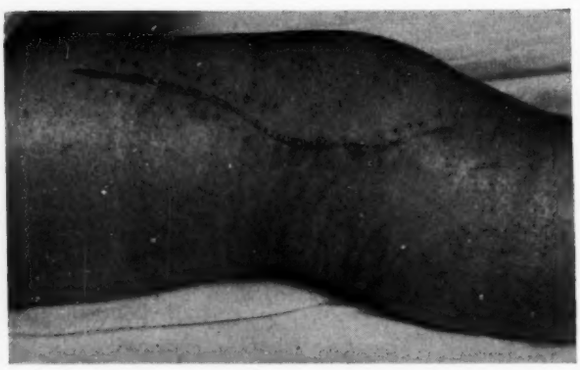

FIG. 7. Postoperative scar on the posterior surface.

FIG. 8. Shows anterior lateral postoperative scar.

knee joint; this mass was diagnosed as villonodular synovitis. (Fig. 1A.)

The many names applied to this lesion were as follows: xanthoma, giant cell tumor, fibrohemosideric sarcoma and polymorphocellular tumor.

In Figure 1B can be seen foam cells (A, E), hemosideric cells (B, C), and multinuclear giant cells (C, D).

From a cytologic interpretation, these cells are derived from basic connective tissue. The diffuse and proliferative quality of the cells in this case should be classified as tumefactive rather than inflammatory. There are no distinctive cell differentiations.

CASE REPORT

R. B., a fifty-four year old white woman, entered the Orthopedic Service of the Hospital of the University of Pennsylvania on March 17th, complaining of swelling about the knee of the right leg. This swelling had been progressive for approximately seven years. Two months prior to admission the patient had noticed some restriction of motion. There was nodular swelling on the anterolateral aspect above the knee joint and swelling on the posterior aspect and below the knee joint. (Figs. 2 and 3.)

According to the history, there was only slight limitation of flexion and increased painless swelling.

Physical examination revealed a firm nodular mass on the anterolateral and posteromedial aspects of the knee joint. X-rays showed no bony changes. All laboratory studies were essentially normal. Aspiration biopsy with a 13 gage needle failed to give any type of specimen for laboratory studies.

A few days after admission a large synovial proliferative mass which was embedded in muscle substance in many places was removed. (Figs. 4 and 5.) Two weeks following the operation a similar but larger mass was removed from the anterior surface of the right leg. The pathologic specimens are shown in Figure 6.

The patient made an uneventful recovery and was again seen two months following surgery. Figures 7 and 8 show the postoperative scars.

SUMMARY

1. A case is presented of a diffuse proliferative synovial lesion of the knee. This lesion was intra- and extra-articular, and was of seven years' duration.

2. The longevity of the lesion with no transition of cell structural changes other than that indicated by multiplicity of the cytologic pattern would classify this type ("pigmented villonodular synovitis") as tumefactive.

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Benign Non-parasitic Cyst of the Spleen

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CYSTIC disease of the abdominal viscera is not an uncommon finding. However, the spleen has no duct system except that of the vascular tree during any period of its development. This apparently accounts for non-parasitic cysts of the spleen being the rarest form of cystic disease of any abdominal organ.

According to Gambill,[1] the first splenectomy reported to have been performed, by Zaccarelli in 1549, is of doubtful authenticity. He credits the first splenectomy to Quittenbaum in 1826; this patient lived six hours and died from shock. Andral, in 1829, recorded the first case of splenic cyst, having found it at autopsy. The first successful splenectomy for cyst is attributed to Pean in 1867.

We find the classification of splenic cysts, based on pathogenesis, to be the most practical.[2] All cysts are either true (primary) or false (secondary), depending upon the presence or absence of a cellular lining, respectively. An extensive search may occasionally be required to find the lining.

ETIOLOGY AND PATHOGENESIS

Arey[3] states that the spleen develops and projects from the dorsal mesogastrium surrounded by peritoneum into the peritoneal cavity as several hillocks. The union of this series of hillocks forms the spleen. Thus it is easy to understand that the peritoneum may be pinched off and form the nidus of a cyst. Most of the cysts are found in the capsule or in the septa running down from the capsule. Therefore, it can be readily explained that the origin is either from dislocated cells or those which have wandered from the peritoneum. In a report by Linn and Elias[4] which describes an epidermoid cyst lined by stratified squamous epithelium with a distinct stratum granulosum and corneum, embryologic maldevelopment is given as the primary factor.

Ectatic cysts stem from the abundant lymphatics and vascular structures which are present in the capsule of the spleen and in the trabeculae.[5] This fact expresses the relationship between an obstruction or dilation of sinuses as being the underlying factor in the formation of these cysts due to mechanical or inflammatory processes.

Shrinkage of an enlarged spleen and consequent folding of the capsule possibly cause the multiple small cysts. Spontaneous hemorrhage from a diseased vessel, as in instances of endarteritis and syphilis, may account for some hemorrhagic cysts. Certainly many hematomas within the spleen are undiagnosed, continuing into resolution and organization. Some of these may form cysts, although despite a history of trauma there need be no direct relationship. In the presence of a cyst there may have been incidental trauma.

Martin, Zega and Adamson[6] performed a series of experiments in which they occluded the blood supply in dogs. No evidence of change suggesting cyst formation was found up to ten weeks after operation. Infarction and atrophy were the pathologic characteristics in the specimens. Strode and Beck,[7] however, reported a cyst of the spleen in a patient with rheumatic pancarditis. Cyst formation was considered as being caused by embolic infarction of the spleen. False cysts are either hemorrhagic or serous. In addition to trauma, other causes are arterial degeneration, secondary hemorrhage in the serous and lymphatic types, infarction, neoplasia and thrombosis of the splenic artery. Of the serous cysts, approximately one-half are due to metamorphosed hemorrhagic cysts.

CASE REPORT

On August 12, 1954, a fifty-six year old Negro woman was admitted with the chief complaint of pain in the epigastrium and left upper quadrant of one year's duration. These pains occurred usually after eating greasy foods and radiated to the left anterior lower chest. In the three months prior to hospitalization the patient had lost 20 pounds. Nausea was present for two weeks prior to admission, but there was no vomiting. The patient had

had constipation most of her life, but it had become more severe one month before admission. There had been no melena or blood in the stools, but grey stools were noted for two days and deep orange urine for one week. For three weeks prior to admission the patient had complained of intermittent chills. She had been told many years before that she had heart trouble. Right oophorectomy and appendectomy had been performed in 1933. She stated that she had been struck sharply in the left upper quadrant with a fist in 1937. This blow was hard enough for her to remember it as having caused pain for a long time. The patient noted dyspnea on exertion and orthopnea unless supported by two or three pillows; she also stated that she had had swelling of the legs which pitted.

Physical examination revealed a thin, well developed middle-aged Negro woman in no apparent distress. Blood pressure was 130/70 mm. Hg. Pulse was 76, temperature 98.6°F. and respirations 20. The scleras were not jaundiced; the conjunctivas were not pale. The pupils reacted to light and extraocular movements were intact. Examination of the ears, nose and throat was negative. A firm anterior cervical lymph node was present on the left side of the neck. The chest was clear and resonant. The heart had a regular sinus rhythm; the tones were poorly heard and no murmurs were audible. Tenderness and rigidity were present in the upper abdomen, more on the right side than on the left. Rebound tenderness was elicited over the upper abdomen, referred to the epigastrium. Tenderness was present over the liver. No organs or masses were felt, but palpation was limited by rigidity. Peripheral edema was not present. Dorsalis pedis pulses were felt bilaterally. Vaginal examination showed a normal non-tender cervix. No adnexal masses or tenderness was present. Rectal examination was negative.

Laboratory examinations revealed the following data: hemoglobin level, 11.7 gm. per 100 cc.; red blood cells, 3,900,000 per cu. mm.; white blood cells, 7,400 per cu. mm. Differential showed 60 per cent neutrophils, 38 per cent lymphocytes and 2 per cent monocytes. Sedimentation rate was 30 mm./hour. Urinalysis was essentially normal. Blood urea nitrogen level was 16 mg. per 100 cc. and total protein level was 7.35 gm. per 100 cc. No free hydrochloric acid was present in the stomach. An electrocardiogram taken on August 13, 1954, indicated myocardial damage. Re-examination on August 25, 1954, was within normal limits. Roentgenographic examination of the chest showed linear interstitial infiltrations beginning from the right hilum into the lung and from the left hilum into the left lower lung. The heart was normal in size and configuration. The aorta was slightly elongated. Numerous buckshots were noted in the left thorax and left lateral chest wall. Examination of the gallbladder showed good concentration with no abnormalities. Upper gastrointestinal series showed a large filling defect in the fundus along its greater curvature. (Fig. 1.) The stomach was not distended in this area. The margins of the defect were somewhat irregular. The roentgenologist suggested the probability of a large irregular mass in the fundus. However, the possibility of extrinsic pressure by the spleen could not be excluded.

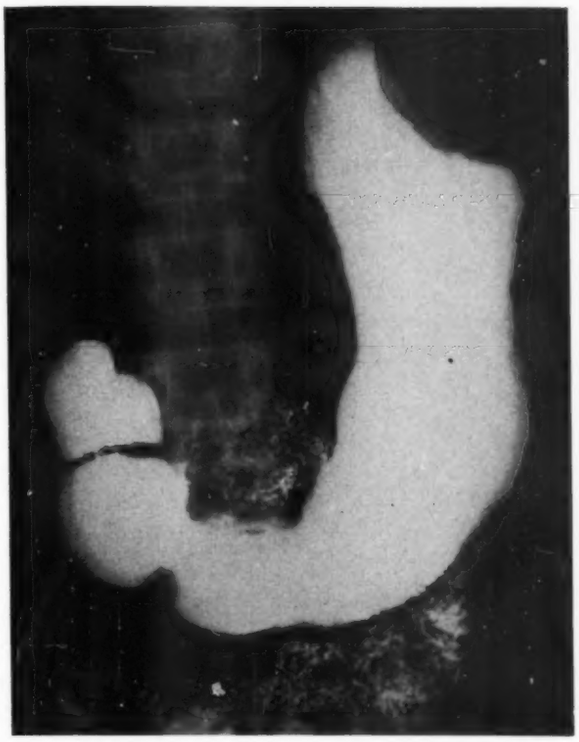

FIG. 1. Preoperative barium meal roentgenogram showing filling defect of fundus of stomach.

Operation was performed on September 8, 1954; the preoperative diagnosis was carcinoma of the stomach. Under general anesthesia, a left paramedian muscle-splitting incision was made. After opening the peritoneum, the stomach, gallbladder, liver, pancreas and small and large bowel were found to be normal. A

FIG. 2. Photograph of specimen.

large cystic mass was found in the spleen. The incision was enlarged downward about 2½ inches and a "T" transverse incision was made toward the left flank, not including the peritoneum and deep fascia. After dividing a few thin adhesions and a well formed phrenicosplenic ligament, the spleen was easily removed by ligating the vessels of the pedicle. The patient received 1,000 cc. of blood during the operation and left the operating room in good condition.

Grossly, the specimen (Fig. 2) consisted of a spleen measuring 8 by 7 by 7½ cm., greyish brown in color, firm and elastic in consistency, and weighing 85 gm. At one end of its poles was a round cyst measuring 6.9 cm. in diameter and embedded in the parenchyma. On section, the cystic cavity contained about 50 cc. of a semigelatinous material of a yellowish grey tinge. The splenic parenchyma appeared congested and its capsule rather thickened. Histologically, the parenchyma was surrounded by a fibrous capsule of increased thickness. The constituent bundles of the capsule disclosed hyaline degeneration. The lymphatic spaces in areas were dilated and infiltrated by isolated lymphocytes. There were a few rather thick trabeculae permeating the parenchyma which also showed hyalinization. The malpighian corpuscles were numerous, with the central artery showing moderate hyalinization. The red pulp was diffusely hemorrhagic, the sinuses dilated; the blood vessels had thick walls mostly hyalinized or fibrotic; macrophages filled with granules of hemosiderin pigment were also seen. The striking feature was dilated blood vessels with thick fibrotic and hyalinized walls. At one area there was a cystic space which permeated deeply into the splenic parenchyma. The wall of the cavity was composed of thick fibrous tissue, poorly cellular, and disclosed a certain degree of hyalinization.

Postoperatively, the patient had a temperature that spiked to 101 to 103°F. until September 20, 1954. Penicillin had been given and on September 15th chloromycetin® was added. She acted rather lethargic after the operation, and on September 11th suddenly became dyspneic. Nasal oxygen was administered and the dyspnea disappeared. An electrocardiogram fortuitously taken about one hour before dyspnea appeared was again definitely abnormal, indicating myocardial disease and tachycardia with a rate of 125 per minute. Chest x-ray on September 13th showed a deformity at the left base probably due to elevation of the diaphragm. On September 16th the chest x-ray showed a collection of fluid at the left base extending up along the lateral chest wall. The costophrenic sinus was obliterated. On September 20th the patient appeared much better and was walking about. She was discharged on September 27th to a convalescent home. Monthly follow-up to March, 1955, indicates an uneventful recovery.

SUMMARY

A case of false serous cyst of the spleen treated with splenectomy is reported.

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An Unusual Complication of Thyroidectomy

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THIS case is reported for the purpose of determining whether the surgeon is safe when he has dissected the recurrent laryngeal nerve in thyroid surgery. Many surgeons have the false sense of security in believing a non-visualized nerve is an intact one. The pseudo-security of this belief needs no discussion. There are also those who believe an identified nerve is a preserved one. This statement is disagreed with in this case.

The complications of thyroid surgery may be divided in respect to (1) the general pre-operative state, (2) the anatomic distortion due to disease, and (3) the abnormal embryologic development. It is the third group of abnormalities into which this case falls. For many years I have been dissecting the recurrent laryngeal nerve prior to removal of the thyroid gland. In spite of this, the following complications occurred.

CASE REPORT

R. M., a twenty-eight year old woman, was admitted to the hospital on June 14, 1949, with a diagnosis of diffuse enlarged thyroid. On June 15th a collar incision was made and each half of the thyroid was exposed. The superior and lateral vessels were exposed, divided and ligated. The recurrent laryngeal nerve was identified well out of the field of vessels to be clamped. The inferior vessels were then clamped, severed and transfixed. The lobes of the thyroid were found adhered to almost the entire circumference of the trachea, and had to be freed by sharp dissection. The entire thyroid substance was removed. All obvious points of bleeding were controlled, a drain was inserted, and the fascial and skin layers were closed. When the intratracheal tube was removed, the patient became cyanotic and a stridor with crescendo developed.

Immediately after the intratracheal tube was reinserted and oxygen administered, the patient's condition improved. After she reacted from the anesthesia, the intratracheal tube was removed. The patient soon began to complain of severe retrosternal pain and increasing difficulty on breathing; again the patient became cyanotic. Roentgenogram of the chest revealed 40 per cent collapse of the right lung. The patient spoke in a whisper. Examination revealed marked hyper-resonance throughout the right lung field. Breath sounds were diminished to absent. An internist was called and he aspirated 1,400 cc. of air from the pleural cavity. This relieved the patient of her discomfort but not of her cyanosis. She was placed in an oxygen tent and her color improved. There was a definite mediastinal crunch. The heart was slightly shifted to the left. Cardiac dullness was replaced by hyper-resonance. Later in the afternoon the patient was much improved. Respiratory difficulty had diminished and her color was good. Mediastinal crunch had subsided markedly. Subcutaneous emphysema was now present in the neck and there was emphysema around the needle wound from aspiration of the right pleural cavity. Blood pressure was 98/80; pulse, 96. She coughed up several masses of bloody mucoid sputum.

The following morning the patient's condition was fair in spite of the stridor. Subcutaneous emphysema appeared on both sides of the neck. The crunch was not audible. Excursions of both hemithoraces appeared fair and indicated no significant pneumothorax. The patient developed a phobia for the closed oxygen tent. In the afternoon she became cold and clammy, her pulse was feeble, blood pressure was 104/80, and her lips were definitely cyanotic. Respiration was labored with paradoxic movement of the sternum. There was hyper-resonance in both left and right sides of the chest.

Consultation with a laryngologist resulted in tracheotomy. Believing that the patient had a high obstruction in the respiratory system, the original incision was opened and the area was infiltrated with novocain.® The trachea was incised and the patient's condition immediately

improved. She was able to cough and bring up thick secretions. Her color improved. A cannula was inserted. Respiration was quiet; pulse was stronger. Six days postoperatively roentgenograms of the chest revealed no evidence of atelectasis or pneumothorax. The patient was discharged from the hospital on June 26th in good condition, still retaining the tracheotomy tube. It was not possible for her to breathe comfortably with the tube blocked. Whenever it was blocked she became cyanotic and respiration became labored.

Six months postoperatively the patient found it difficult to block the tube for more than two to three minutes at a time. Repeated examination of the vocal cords revealed them to be tightly opposed. There was no evidence of motion or loss of tone.

This patient remained under our care for the duration of her illness and is at present still under supervision. She is enjoying good health except for the tracheal cannula. When she suffers no emotional or physical strain, she can tolerate blockage of the opening of the tube. However, when she becomes excited or when there is a greater demand for oxygen, the vocal cords will not permit the increased intake. There has been no evidence of relaxation of the cords from the onset of her illness to the present.

Consultations with laryngologists have been numerous and their opinions conform. They do not believe that plastic surgery would relieve the patient's distress.

COMMENTS

This case demonstrates that dissection of the anterior triangle of the neck should not satisfy the surgeon unless a careful search is made for possible division of the laryngeal nerve. Lahey[1] points out that the laryngeal nerves in monkeys can be divided into two sets of fibers: adductor and abductor portions, with predominance of the adductor fibers. Lahey[1,2] also points out that one is not likely to injure the adductor bilaterally and produce a distressing emergency. This case conforms to the one Lahey says "may conceivably take place."[1]

Armstrong and Hinton[3] have demonstrated that 73 per cent of nerves divided extralaryngeally. Their dissections showed that 66 per cent divided into two divisions of equal size. The case reported herein falls into the category in which the abductor and adductor fibers traveled in individual bundles. After exposing both apparent recurrent laryngeal nerves, the procedure was carried out in blind security. The nerves exposed were the adductor fibers, and the abductor was severed bilaterally. This caused the cords to approximate, and the forceful attempt at expiration caused the rupture of the lung tissue. Air then escaped along the course of the great vessels causing mediastinal emphysema.

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Neuromyoangioma of the Leg with Symptoms Similar to Glomus Tumor

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PAINFUL vascular tumors are so uncommon that they are often unrecognized and therefore mistreated for a long time. Furthermore, the fact that these tumors occur in parts of the body other than the hand is often forgotten; hence, they are not thought of in the differential diagnosis of painful syndromes.

The common lesion is the glomus tumor, not a true neoplasm but a malformation (hamartoma) of a normal structure. It is composed of a network of vessels, all of which contain characteristic epithelioid or glomus cells. King[1] points out that smooth muscle, fibrous tissue and nerve tissue may occur in considerable amounts and occasionally may predominate. Thus they merge imperceptibly into vascular and muscle tumors of the skin or subcutaneous tissue. Many of these latter tumors may produce the characteristic severe pain which is stimulated often by touch or temperature change. The following case report illustrates the clinical picture in one such tumor.

CASE REPORT

S. S., a fifty-five year old woman, had noted an occasional sticking feeling on the anterior surface of the right leg for about six years. These were momentary "flash" pains. Two years before admission a painful spot was noted on the leg about 8 cm. below the knee. There was pain on touch, but it also appeared spontaneously. One year later a small pea-sized mass was observed in the subcutaneous tissues at the painful spot. The patient then began to notice a relationship of the pain to cold. The pains would appear three or four times daily during cold weather, but were absent in summer. Damp weather increased the pain. It was often brought on if a draft of cold air struck the leg. She stated that occasionally at the movies a draft of cold air from the air conditioner would produce excruciating pain, so she learned to take off her shoe and sit on her right leg to avoid such episodes.

The pain was intense, as if a knife was being thrust through the leg. It was always localized to the anterior surface of the leg and did not radiate. The attacks of pain at first occurred only about once a week and lasted only a moment, but as time went on the pains appeared several times daily and lasted two or three minutes.

X-ray studies made before she entered the hospital were said to show periostitis of the tibia. Large doses of penicillin had been administered, but without relief.

Examination revealed a small pea-sized nodule in the subcutaneous tissue medial to the tibia. It was extremely sensitive to pressure. There was no discoloration or edema of the overlying skin and no temperature change to mark its location. At operation, a firm grayish red nodule about 1 cm. in diameter was found in the subcutaneous tissues. It was well encapsulated. Several small vessels connected to it were divided and ligated, and the mass was removed *in toto*.

The recurring pains previously present did not recur after operation and she has no symptoms, even when the leg is exposed to cold or even ice.

Pathologic examination of the specimen showed a mass composed of all the elements of a glomus tumor except the characteristic "glomus" cells. The tumor was therefore diagnosed as akin to a glomus tumor, a neuromyoangioma.

SUMMARY

A case is reported of a subcutaneous neuromyoangioma of the leg producing severe attacks of local pain brought on by cold. The symptoms are similar to those commonly associated with a glomus tumor but the pathologic examination failed to show glomus cells. Excision of the nodule produced immediate relief.

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The American Journal of Surgery

Editor THURSTON SCOTT WELTON, M.D., NEW YORK

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VOLUME 91

JANUARY TO JUNE

1956

THE AMERICAN JOURNAL OF SURGERY, INC.

49 WEST 45TH STREET, NEW YORK 36, N. Y.

MCMLVI

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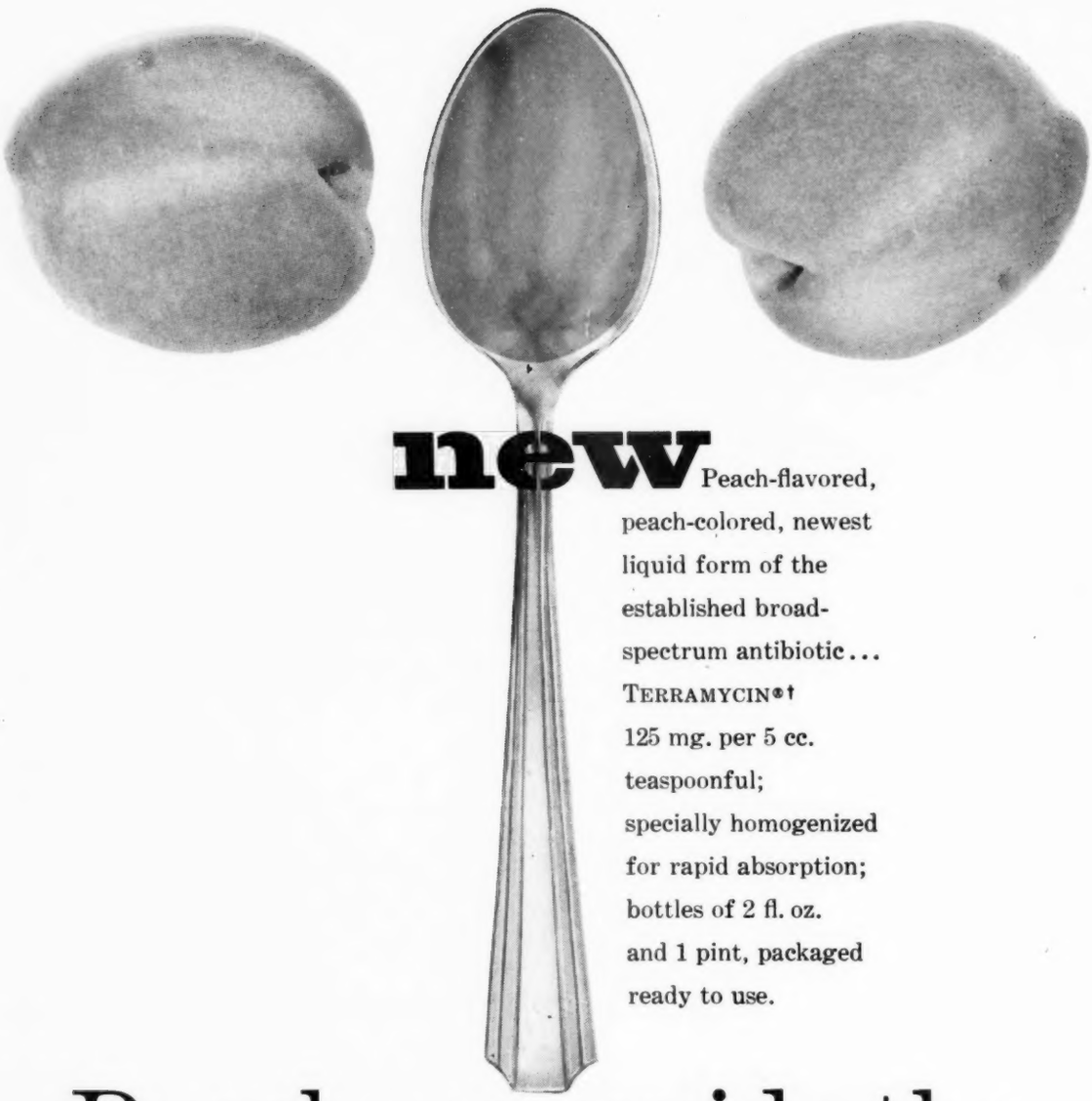

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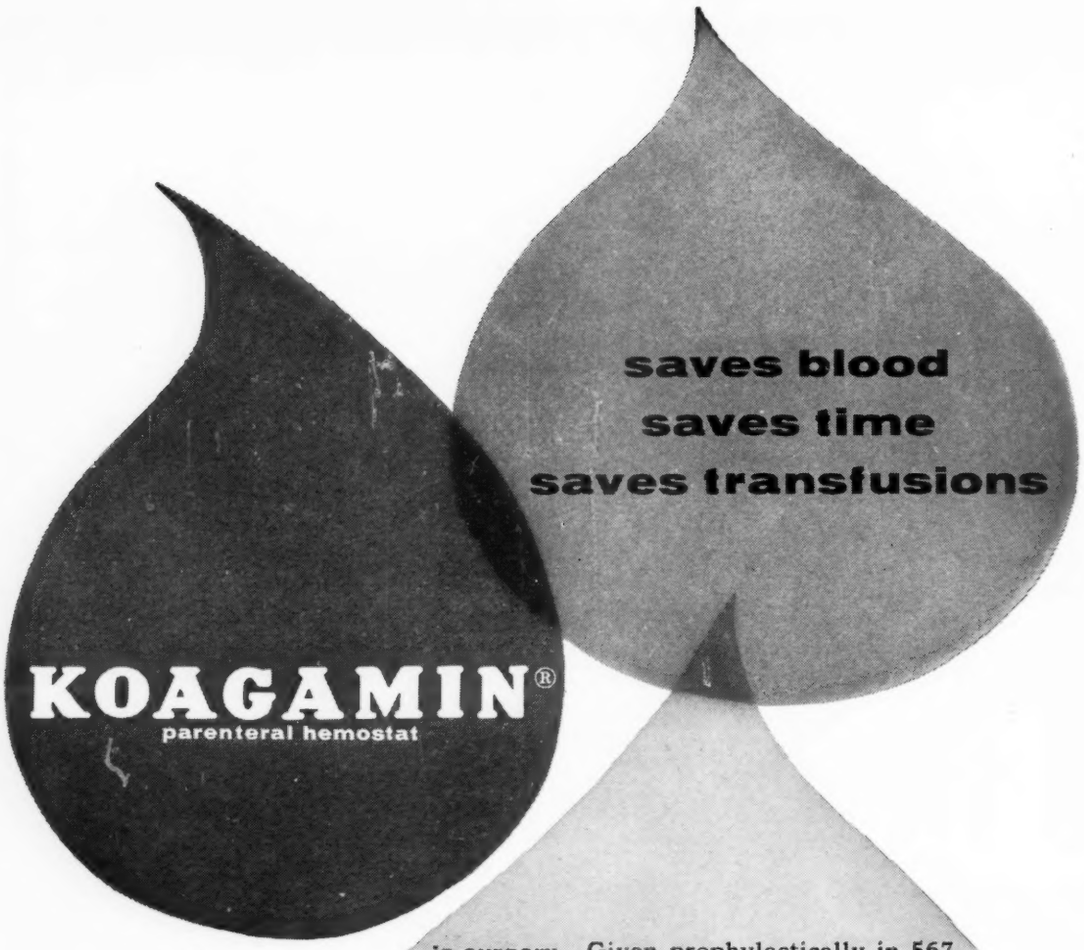

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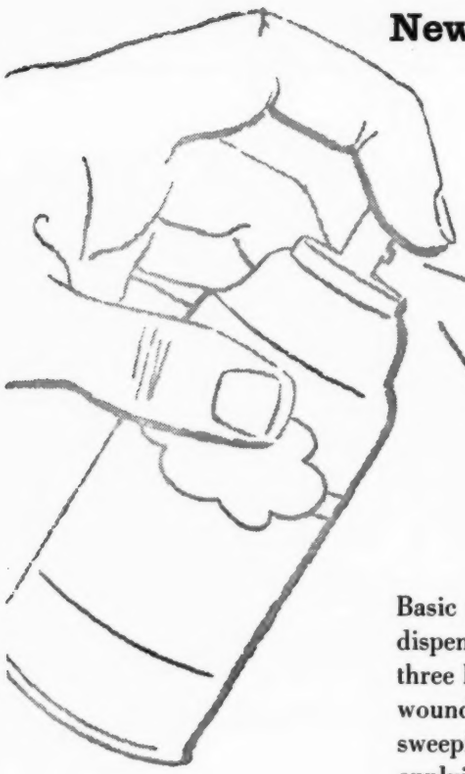

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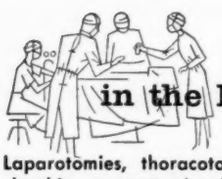

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3. Rigler, S. P., and Adams, W. E.: Surgery 36:792 (Oct.) 1954.
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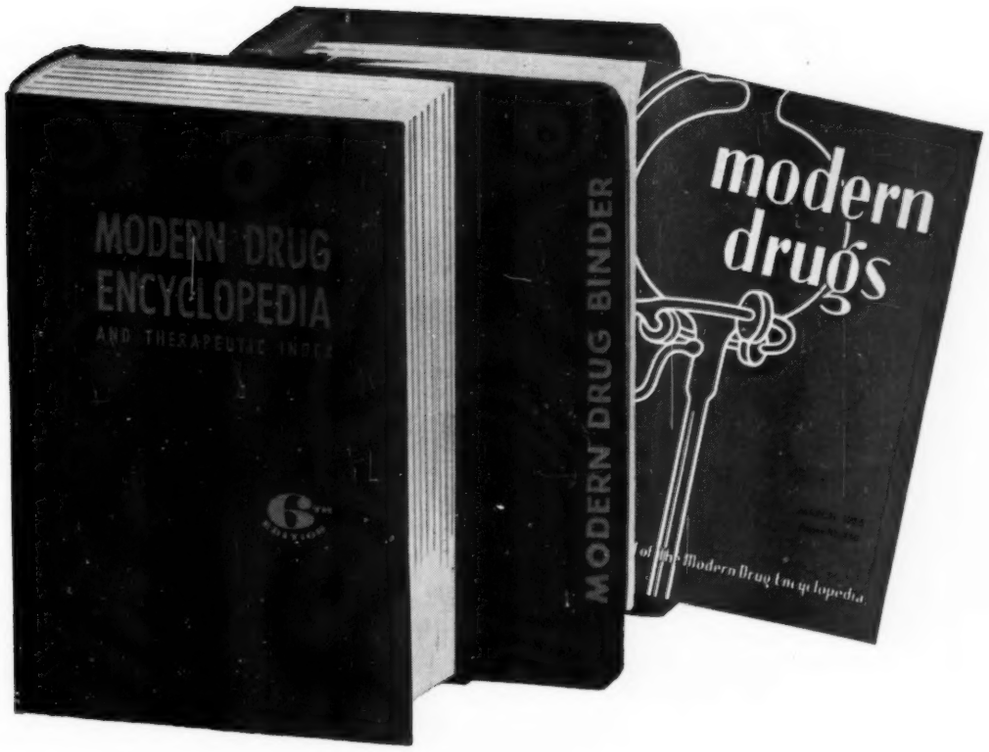

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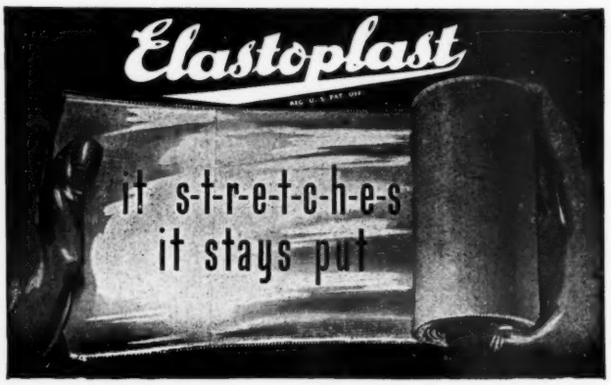

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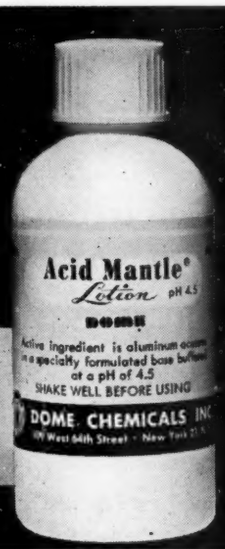

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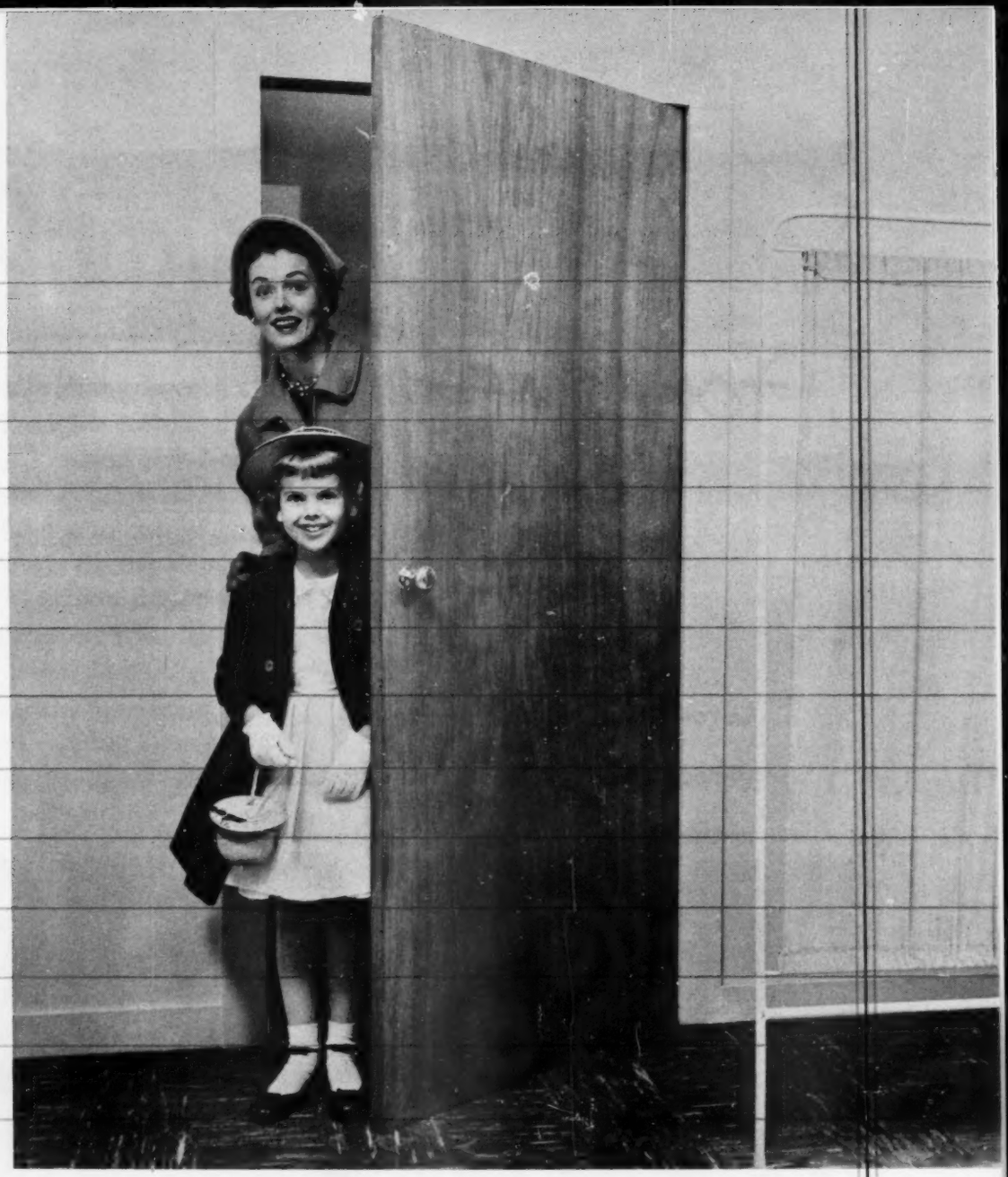

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NOTES AND QUOTES

The following release is a public warning against the Hoxsey cancer treatment from the U. S. Department of Health, Education, and Welfare, Food and Drug Administration, Washington 25, D. C.:

Sufferers from cancer, their families, physicians, and all concerned with the care of cancer patients are hereby advised and warned that the so-called Hoxsey treatment for internal cancer has been found by the United States Court of Appeals for the Fifth Circuit, on the basis of evidence presented by the Food and Drug Administration, to be a worthless treatment. (The court decisions can be found in Volume 198, Federal Reporter, Second Series, page 273, and Volume 207, Federal Reporter, Second Series, page 567.)

The Federal Food, Drug, and Cosmetic Act authorizes dissemination of information regarding drugs in situations involving imminent danger to health or gross deception of the consumer. (21 U.S.C. 375 (b) This authority has been delegated to the Commissioner of Food and Drugs by the Secretary of Health, Education, and Welfare, 20 Federal Register 1998.)

The Hoxsey treatment for internal cancer involves such drugs. Its sale represents a gross deception to the consumer. It is imminently dangerous to rely upon it in neglect of competent and rational treatment.

The Hoxsey treatment costs the patient $400 plus $60 in additional fees; expenditures which will yield nothing of any value in the care of cancer. It begins with a superficial and inadequate examination of the patient at the Hoxsey Cancer Clinic, Dallas, Texas, or Portage, Pennsylvania. The patient at Dallas is then supplied with one of the following "cancer" medicines: Black pills, red pills, a brownish-black liquid, or a light red liquid. The black pills and the brownish-black liquid contain: Potassium iodide, licorice, red clover blossoms, burdock root, Stillingia root, berberis root, poke root, cascara sagrada, prickly ash bark, and buckthorn powder. The red pills contain potassium iodide, red clover, Stillingia root, poke root, buckthorn, and pepsin. At Portage the patient is given the same "cancer" medication although the colors of the pills are different. The light red liquid medicine is potassium iodide in elixir of lactated pepsin. There is evidence that potassium iodide accelerates the growth of some cancers.

The Food and Drug Administration has conducted a thorough and long-continuing investigation of Hoxsey's treatment. His claimed cures have been extensively studied and the Food and Drug Administration has not found a single verified cure of internal cancer effected by the Hoxsey treatment. In addition, the National Cancer Institute of the United States Public Health Service has reviewed case histories submitted by Hoxsey and advised him that the cases provided no scientific evidence that the Hoxsey treatment has any value in the treatment of internal cancer.

On October 26, 1953, Harry M. Hoxsey, the Clinic, and all persons in active concert with him were enjoined by the United States District Court at Dallas, Texas, from shipping their worthless cancer medicines in interstate commerce with labeling representing, suggesting, or implying that the products are effective in the treatment of any type of internal cancer. While the Government intends to prosecute violations of the injunction, this warning is necessary for the immediate protection of cancer victims who may be planning to take the Hoxsey treatment.

Those afflicted with cancer are warned not to be misled by the false promise that the Hoxsey cancer treatment will cure or alleviate their condition. Cancer can be cured only through surgery or radiation. Death from cancer is inevitable when cancer patients fail to obtain proper medical treatment because of the lure of a painless cure "without the use of surgery, x-ray, or radium" as claimed by Hoxsey. (Signed: Geo. P. Larrick, Commissioner of Food and Drugs.)

Chemists have learned to capture the odors of the atmosphere and take them to the laboratory to aid in the study of air pollution, Dr. Amos Turk of City College recently told a scientific Conference of the American Chemical Society's New York Section.

Rather than move observers and elaborate equipment to the site under study, researchers have devised methods for concentrating and handling the gaseous contaminations contained in large seg-

CONTINUED ON PAGE 48

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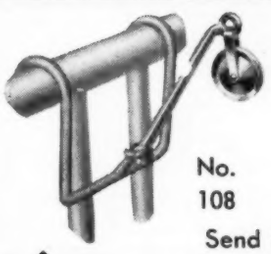

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ments of air, said Dr. Turk who is an instructor in chemistry and a chemical consultant.

In concentrated form, Dr. Turk explained, atmospheric smells may be readily carried back to the laboratory where they can be analyzed and identified. This scientific transporting of "the mountain to Mohammed" is seen as an aid in detecting the sources of odoriferous pollution, thereby leading to their elimination.

A promising method has been devised, using granular carbon which has been specially prepared, the speaker observed. He said the method can be highly efficient and simple to use. After the sample is brought back to the laboratory, he noted, it can be reconstituted into an air stream or even used to create an atmosphere similar to the original.

TWELVE leading universities trained more than half of the 11,407 students who received doctorate degrees in the natural sciences in the period from 1946 to 1950, according to a recent survey of the National Research Council. Of the 11,407 graduate students in this category, 5,478 were educated at the twelve schools. The University of Wisconsin led the list with 689 doctorates in the natural sciences, followed by Cornell with 559, M.I.T. with 553, California (Berkeley) with 543, Illinois with 517, Ohio State with 516, Harvard with 445, Minnesota with 427, Chicago with 410, Columbia with 384, Purdue with 364, and Michigan with 342.

Accidental loss of life from fires and burns by other means is nearly three times as high and that from poisonous gas five times as high in winter as in summer, according to a study by statisticians of the Metropolitan Life Insurance Company. Both classes of fatalities are associated largely with the increased use of heating facilities.

Many fatalities from poisonous gas, the statisticians report, result from improperly installed or defective heaters. An appreciable number are due to running an automobile motor in a closed garage or in a parked car.

Fatal falls also are at a maximum in winter, although the rise is relatively moderate. The death toll for February, the peak month, is only about 8 per cent higher than the annual average.

A GRANT of $85,000 to Columbia University from the Carnegie Corporation of New York will support an American Assembly on United States representation abroad, the philanthropic foundation announced recently. About fifty leaders of business, labor, government and education gathered at Arden House in Harriman, New York, from May 3rd to 6th. They discussed problems of U. S. representation overseas in the economic, informational and cultural, and military fields; participation in international organizations; and coordination of overseas representation.

Clare Booth Luce, U. S. Ambassador to Italy, and Grayson Kirk, Columbia University President, addressed the sessions.

The American Assembly was established by Dwight D. Eisenhower when he was President of Columbia University. It is a program of continuing conferences which bring together labor, business, farm groups, the professions, political parties and government representatives, with the aim of throwing impartial light on major problems which confront the nation. Earlier sessions have considered problems of U. S.-Western European relations, inflation and economic security. The last Assembly, on state government, was supported also by the Carnegie Corporation. Dr. Henry Wriston, former President of Brown University, is Director of the Assembly.

An improved orthopedic screw driver is being offered for the first time by the Orthopedic Equipment Co., Bourbon, Indiana. This instrument is developed to handle all makes and types of bone screws. The universal style bit is self-centering and no extra bits are needed. The spring tension on the bit is easily controlled for angulation and for final setting of the screw. Closing of the lever locks the screw in place for driving, and opening of the lever releases the screw. The tool is of stainless steel construction, with a knurled aluminum handle, and is easy to clean. Known as the No. 464 screw driver, the list price is $27.50.

GRANTS totaling $234,853 have been made to sixteen outstanding medical school teachers and researchers for the 1956 American Cyanamid Company's Lederle Medical Faculty Awards, it was announced by K. C. Towe, President. The awards, believed to be the first

CONTINUED ON PAGE 50

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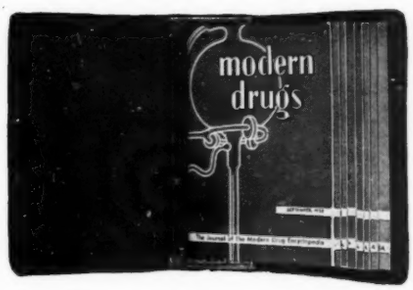

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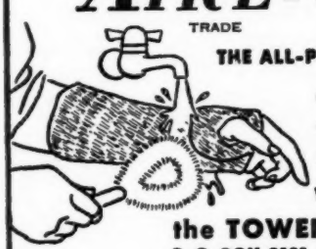

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of their kind in the field, were initiated by American Cyanamid in 1954.

"The basic purpose of the grants is to help assure schools and universities adequate funds to maintain promising medical men in teaching and research posts," explained Mr. Towe. "The awards are intended to augment salaries or to aid schools in filling such positions."

"To help insure the health of future generations of Americans, we feel that no more significant contributions can be made than those to our great medical teaching institutions," Mr. Towe declared.

One hundred pounds of tuber-producing cortisone recently flown up from deep in a South American jungle is expected to turn Puerto Rico into one of the world centers for wonder drugs. Authorities said the initial planting will fill 1,000 acres. Known scientifically as Dioscorea, the yam-like plant will eventually cover 15,000 to 20,000 acres of previously useless swamplands. This will be the first project to put Dioscorea under extensive cultivation. Most of the world's supply of cortisone now comes from Mexico where the plant grows wild.

THE first vehicle in history for use in transporting germ-free animals will be built by Studebaker for the Lobund Institute of the University of Notre Dame. The joint announcement of the project was made by Harold E. Churchill, Studebaker division General Manager, and Professor James A. Reyniers, Founder and Director of the Lobund Institute.

The vehicle is to be built from specifications developed jointly by the research scientists of the Institute and Studebaker's research engineers, and will provide transportation for the experimental animals from the Institute to laboratories within 1,000 miles where germ-free experiments are scheduled. Until now, scientists wishing to use these unique animals had to use the facilities at Lobund.

Germ-free animals are particularly important in medical and biological research on the probems of tooth decay, radiation sickness, cancler and the aging process.

The Lobund Institute was the first to breed germ-free animals, and continues to be the only source of supply for them. In order to transport them to other research laboratories which required their use, a special vehicle had to be constructed which could maintain during transit the same conditions prevailing in their home laboratory.

Germ-free animals for medical and biological research are obtained from the mother before birth, since the animal before birth is generally in a germ-free state. Frequently several germ-free animal generations must be born before a standardized germ-free animal can be obtained.

After removal from the mother, the infant creature is placed in a sterile tank where the air it breathes is carefully filtered and sterilized, temperature and humidity are maintained at constant levels and all its food and water are steam-sterilized before serving.

The tranquilizing drug miltown has brought relief from the pain of cancer to twenty-three of fifty-three patients, some in the terminal stages of the disease, according to a report by Drs. L. N. Kessler and R. D. Barnard, New York.

Pain was sufficiently controlled in the twenty-three patients so that the need for opiates, which often hinders treatment of the disease, was eliminated. All the patients were suffering from inoperable cancer and were being treated with hormones and antibiotics.

Successful use of the tranquilizing drug "is an indication," the doctors stated, "that the psychic factor of pain in cancer should not be underestimated."

The twenty-three patients who benefited from miltown showed increased appetites, improvement in attitude and interest in objective matters, the doctors said, "enough to establish that continued use of miltown was indicated."

What was formerly a bleak outlook for many patients with inoperable cancer has been brightened somewhat in recent years, the doctors pointed out, by advances in hormonal, nutritional and supportive therapies, and there have been reports of reversal of the disease "with prolonged, renewed active life span."

Drugs commonly used for the relief of pain, such as the narcotics or depressants, however, "could themselves constitute a lethal complication of cancer," Drs. Kessler and Barnard emphasized, "and could impose limitations on the supportive treatment employed."

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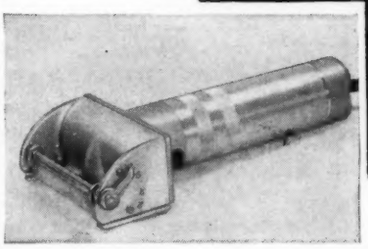

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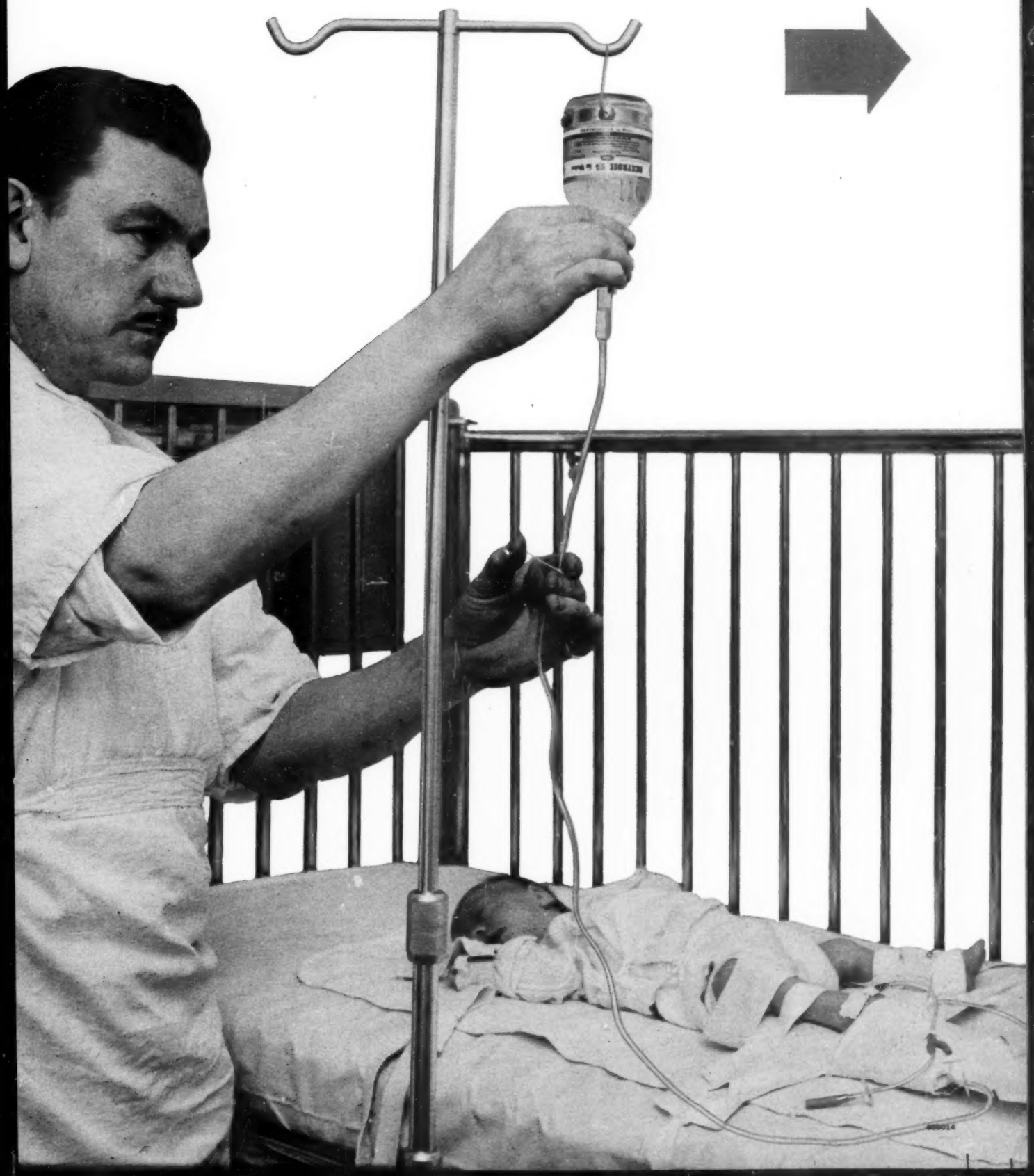

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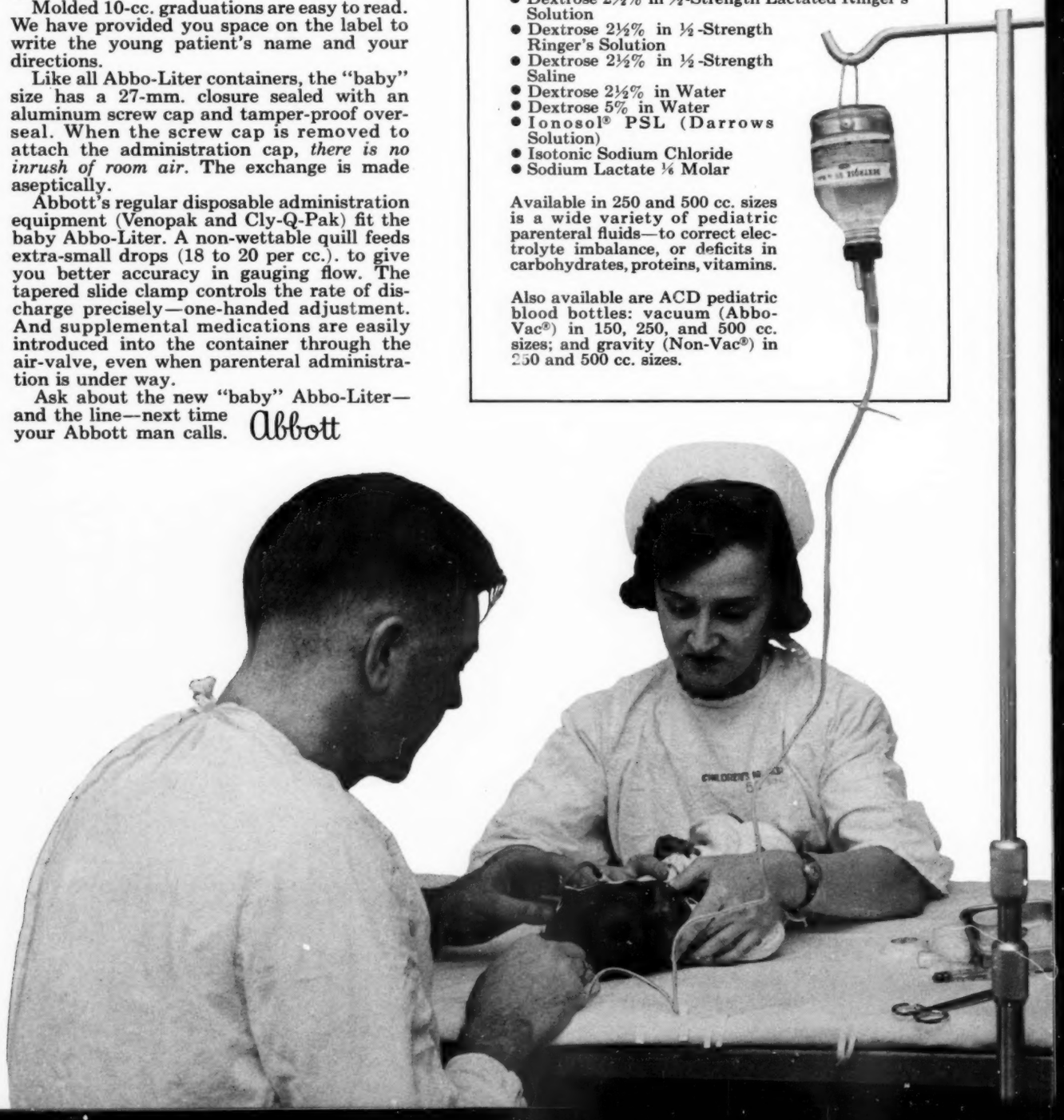

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